OPERATION TEAM SPIRIT:
PROGRAM REVIEW AND ANALYSIS

GRADUATE RESEARCH PROJECT

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Abstract

Several years ago, Air National Guard (ANG) maintenance personnel spent an average of 52 days performing acceptance inspections due to the poor quality of KC-135 aircraft returning from programmed depot maintenance. In an effort to improve this quality and reduce downtime, the ANG requested owning units be permitted to perform a portion of their acceptance inspections on aircraft while still at depot facilities. This request evolved into the Team Spirit (TS) program. Following its implementation, the TS program reportedly drove average downtimes from 52 days to 14, drawing attention from leaders at the Air Force's highest levels. The Chief of Staff of the Air Force awarded the TS program's originators with the prestigious Team Excellence Award and designated it as an Air Force Best Practice.

Since earning these accolades, the program has undergone scrutiny over increasing costs. Decision makers placed the program on hold at Oklahoma City Air Logistics Center and directed a business case analysis (BCA) be conducted to determine the best course of action. Although the BCA confirmed that costs had in fact risen, the overall results favored the program's continuation due to myriad other benefits. Despite the BCA results and resumption of the TS program, scrutiny of the award-winning program had not completely waned—rather, its focus had shifted. Evidence of revenue losses not only served as the impetus for the BCA, but also identified a need for a qualitative analysis of TS processes in an effort to identify potential areas for improvement—hence, the focus of this study.

Based on data collected through a combination of questionnaires, interviews, and personal observation, the study reveals a number of areas in need of focused improvement efforts. These areas can be summarized into the following broader categories: *communication*, *standardization*, *formalization*, and *process ownership*. Several specific recommendations are provided to guide immediate improvement efforts as well as encourage the establishment of a formal continuous process improvement mechanism.

I would like to dedicate this work to the "knucklebusters"
on the flightline, in the backshops, and at the depots across this great Air Force.

Aircraft maintenance is often a thankless job,
but it is through the diligence, dedication, and ingenuity of our maintenance workforce
that our aircraft dominate the skies today and will continue to do so well into the future.

Acknowledgments

I would like to thank my advisor, Lt Col Stephen Chambal, for his support, guidance, and contagious energy. I would also like to express a thank you to the faculty and staff within the halls of AFIT for making IDE a memorable experience.

To my classmates, thanks for making the program and related coursework bearable. The insights and experiences you shared made for interesting class discussions and helped expand my perspective of our Air Force.

Finally, I would like to thank my wife and son for their patience, understanding, and continued support. I love you both very much.

Eric E. Morgan

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"Quality is everyone's business." -- W. Edwards Deming

Background

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Aerial refueling is a critical enabler to accomplishing the primary missions of the United States Air Force (USAF), most notably global reach and global power. The bulk of US—and allied—air refueling capabilities resides in the USAF fleet of tankers, including the KC-135 Stratotanker. A clear example of this dominance occurred during the major combat phase of Operation IRAQI FREEDOM, when KC-135 and KC-10 aircraft satisfied over 95 percent of air refueling requirements for all US and coalition aircraft (DSB, 2004).

The KC-135 makes up about 90 percent of the USAF tanker inventory, making it the nation's primary military aerial refueling platform (DSB, 2004). KC-135s are managed and operated by Air Mobility Command (AMC); however, they are Total Force assets as both the Air National Guard (ANG) and Air Force Reserve Command (AFRC) fly them as well, typically in support of AMC missions (DAF, 2008a). Two versions of the KC-135 are being flown today—the KC-135E and KC-135R. Both are upgraded from the original KC-135A model, which rolled out of Boeing production lines in the late 1950s and early 1960s. Among the upgrades, the KC-135E and KC-135R received new engines, along with improved fuel efficiency and increased fuel offloading capability.

An Aging Fleet.

Despite the upgrades and enhanced capabilities, the KC-135 cannot overcome all of the effects attributed to an aging airframe. Worse yet, the KC-135 airframe—the same airframe the USAF is flying today—was originally "built in an era of 'throwaway aircraft.' Manufacturers adopted assembly techniques, such as lapping two pieces of metal without sealant, which makes aircraft corrosion prone" (Ott et al, 2008). In fact, the KC-135 was originally fielded as an "interim" jet tanker to meet the demand of Strategic Air Command in the mid-1950s for a jet-powered tanker to replace the propeller-driven KC-97 (DSB, 2004).

Corrosion and other age-related signs of material degradation have made maintainability and reliability key concerns among top military officials. The Department of Defense (DoD), as well as the USAF, has requested several independent analyses of the Service's aerial refueling capabilities, with particular emphasis on the aging fleet of KC-135 tankers. In a 2004 report to the Under Secretary of Defense for Acquisition, Technology, and Logistics, a Defense Science Board Task Force confirmed these age-related maintenance concerns. Fortunately, the task force also highlighted "evidence of a maintenance regime well poised to deal with corrosion and other aging problems" (DSB, 2004).

Increasing Demands.

Age-related material degradation isn't the only cause for concern. Despite its age, the KC-135 remains a high-demand asset. With continued home station training activities as well as ongoing operations around the world—including both Operations

ENDURING FREEDOM and IRAQI FREEDOM—there remains a constant, if not growing, demand for aerial refueling.

Since fiscal year 2001, the KC-135's operational tempo has increased 33%, a significant increase beyond the flying hours originally planned (Ott et al, 2008). Part of this increase is an expanded repertoire beyond its core mission of aerial refueling and secondary mission as an airlift asset. Some of these new missions include refueling unmanned and special operations aircraft, aero-medical evacuation, and serving as an airborne communications gateway (Ott et al, 2008).

No Relief in Sight.

According to a 2007 RAND study, "aging Air Force fleets have accrued material deterioration problems that have resulted in increasing maintenance workloads, which have, in turn, led to reduced availability of the fleets for operations and training" (Loredo et al, 2007). Age, along with a consistently high operations tempo and expanded mission set, has and will continue to have significant ramifications on the maintainability and reliability of the KC-135 aircraft. So much so that former Chief of Staff of the Air Force, General T. Michael Moseley, placed KC-135 recapitalization at the top of the USAF's list of acquisition priorities (DAF, 2008b). Myriad procurement issues have contributed to successive delays in the recapitalization effort, including the delay associated with Boeing's protest of the contract award to Northrop-EADS (Ott et al, 2008).

If and when the tanker recapitalization effort assumes a stable course, the first KC-135 replacement aircraft will not be operational for several years. Hence, the USAF will need to remain reliant on the KC-135 even further beyond its intended service life.

As such, maintenance of this aging, yet high-demand asset will continue to grow in criticality—at all levels of the USAF maintenance construct.

Maintenance Construct.

USAF aircraft maintenance is comprised of three levels: organizational, intermediate, and depot (DAF, 2006b). Organizational maintenance is performed at the field level. Operating or flying wings possess a certain degree of aircraft maintenance capability at the flightline level. This capability is known as organizational maintenance, and the type of maintenance performed is referred to as on-equipment (DAF, 2006b).

Intermediate-level maintenance can also be performed within operating wings, but it deals primarily with off-equipment maintenance in facilities known as backshops (DAF, 2006). Intermediate-level maintenance can also be performed at centralized repair facilities and, like backshops at the wing level, deals mainly with off-equipment maintenance.

Depot maintenance, as its name implies, is performed at depots and may involve both on- and off-equipment maintenance activities (DAF, 2006b). Air Force Technical Order 00-25-4 (2006) provides a more thorough definition of depot-level maintenance:

> *The level of maintenance consisting of those on- and off-equipment tasks performed using highly specialized skills, sophisticated shop equipment, or special facilities of an air logistics center (ALC), centralized repair activity, contractor facility, or, by fields at an operating location. Maintenance performed at a depot also includes those organizational- and intermediate-level tasks required to prepare for depot maintenance, and, if negotiated between depot and the operating command, scheduled field-level inspections, preventative maintenance, or time-compliance technical orders which come due while equipment is at the ALC for programmed depot maintenance.*

Programmed Depot Maintenance.

To address the impacts of age- and usage-related effects, the KC-135 undergoes programmed depot maintenance (PDM). PDM involves inspection and correction of defects that require skills, equipment, or facilities not normally possessed by operating locations (DAF, 2006c). In a general sense, aircraft enter PDM on regularly scheduled intervals and are systematically dismantled; inspected and, if needed, tested and/or repaired; and restored to a safe operating condition before returning to home station (Loredo et al, 2007).

Figure 1 illustrates the typical KC-135 PDM process. The KC-135 undergoes PDM via both organic and contract sources of repair (SORs). Organic PDM is conducted at Oklahoma City ALC (OC-ALC) (West, 2007). The organic line handles about 80-85 KC-135 PDMs each year, generating approximately $640 million in revenue (Ott et al, 2008). Two different contractors accomplish the remaining PDM requirements: Boeing and Alabama Aircraft Industries, Inc. (AAII) (Ott et al, 2008).

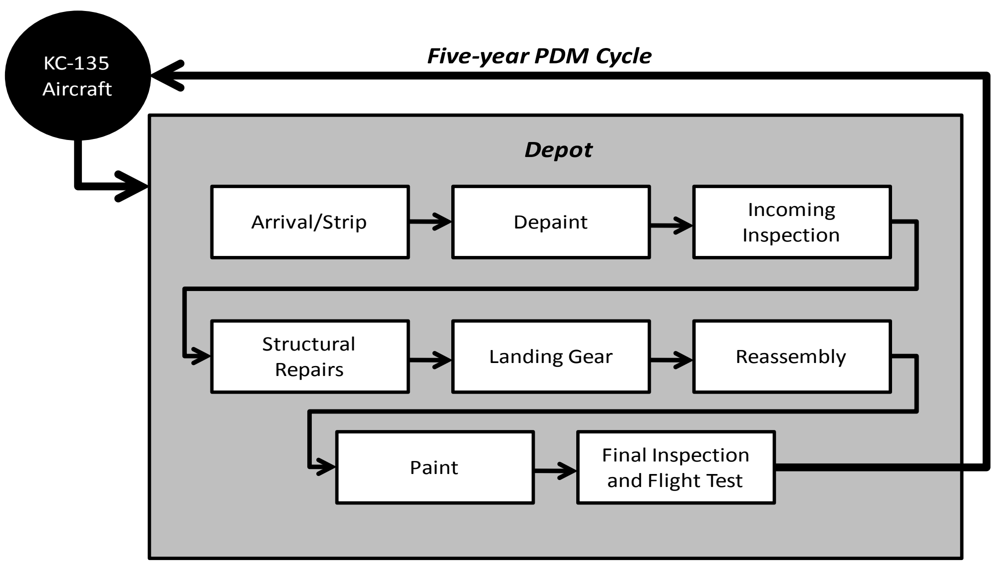

Figure 1. KC-135 PDM Process (Loredo et al, 2007)

Operation Team Spirit.

In 2000, ANG maintenance personnel found themselves spending an average of 52 days performing acceptance inspections on KC-135 aircraft returning from PDM facilities (West, 2007). The poor quality of aircraft being delivered by the PDM SORs drove this extensive downtime. The ANG owning units expended much of this downtime on rework; in some extreme cases, aircraft were returned to the PDM facilities to rectify major discrepancies (Cerino, 2008). In an effort to improve this quality and subsequently reduce post-PDM downtime, the ANG requested PDM SORs allow owning unit maintenance personnel perform a portion of their home station acceptance inspections on aircraft before they returned from the PDM facilities.

In 2001, Boeing, one of the two contract SORs, was the first to oblige at its PDM facility in San Antonio. Since then, all SORs—including OC-ALC and AAII—have followed suit. AFRC joined the ANG by requesting similar changes be made to its KC-135 PDM process. AMC, however, continues to operate under the original PDM construct. In fact, AMC reports an average downtime of just three days before adding its aircraft to the flying schedule. This relatively short downtime has been attributed to prevailing mission demands calling for active duty units to perform less extensive acceptance inspections (deFonteny, 2008).

The ANG's initial request to change the PDM process evolved into what is known today as Operation Team Spirit, a program made official in 2006 by the establishment of a memorandum of understanding (MOU) between the following stakeholders: Air National Guard; Air Force Materiel Command; Air Mobility Command; Air Force

Reserve Command; and Defense Contract Management Agency (TMD, 2006). Implementation of the Team Spirit (TS) program represented a marked change to the previous ANG and AFRC KC-135 PDM process. Prior to TS, aircraft entered the PDM facility where they were disassembled and repaired in accordance with previously agreed-to work packages or PDM contracts. Following completion of PDM, aircraft returned to home station where owning units would subsequently perform acceptance inspections (West, 2007).

Under the TS construct, owning units send maintenance personnel to PDM facilities to perform a portion of their acceptance inspections before aircraft return home (West, 2007). This team of maintenance personnel, referred to as TS inspectors, typically arrives to perform the inspections during the latter portion of the reassembly phase, prior to the aircraft entering the paint phase. Timing the inspections in this manner allows TS inspectors to access certain areas of the aircraft before panels and floorboards are reinstalled.

Since its implementation, the TS program has reportedly driven aircraft downtime associated with home station acceptance inspections and associated rework from an average of 52 days to 14 for ANG KC-135 aircraft (West, 2007). This equated to more than a 70 percent increase in aircraft availability, drawing attention from leaders at the Air Force's highest levels. In 2007, the Air Force Chief of Staff presented the TS team with the Chief of Staff Team Excellence Award (Salomon, 2007). Additionally, TS was identified as an Air Force Best Practice and has since been adopted by other organizations, including Ogden Air Logistics Center (OO-ALC) on its F-16 depot line.

Problem Motivation

Since earning Chief of Staff-level accolades, the program has undergone scrutiny over increasing costs. The KC-135 program office reported TS program-related revenue losses of $1.093 million and $1.33 million (projected) for fiscal years (FY) 2007 and 2008, respectively (Kramer, 2008). The program office attributed the losses directly to growing repair costs resulting from discrepancies found during TS inspections. Senior leadership at OC-ALC became concerned and directed a business case analysis (BCA) be conducted to determine the best way ahead for the program. As a result, the TS program was put on hold at OC-ALC until completion of the BCA; meanwhile, TS efforts continued at both contractor PDM locations.

Although the BCA confirmed that TS inspections were in fact generating costs beyond what was originally budgeted for, the overall results favored continuation of the TS program (deFonteny et al, 2008). Specific recommendations included expending an additional $3,200 per aircraft based on findings reflecting improved quality and customer confidence, as well as increased aircraft availability. The program has since been re-instituted at OC-ALC.

Problem Statement

Despite the results of the BCA and ensuing resumption of the TS program at OC-ALC, scrutiny of the award-winning program had not completely waned—rather, its focus had shifted. Evidence of revenue losses not only served as the impetus for the BCA, but also identified a need to the ANG for a qualitative analysis of TS processes in an effort to identify potential areas for improvement.

Research Objective

The objective of this research is to identify areas where process improvement efforts may have the greatest impact on the TS program and related processes. The research is based on input from various TS participants, personal observations, and insight gleaned from the literature. General areas, as well as specific actions, aimed at improving the overall effectiveness and efficiency of the program serve as the primary focus.

Methodology

The methodology employed in this research was strictly qualitative in nature. The specific method being used was exploratory case study analysis. Data were collected using various qualitative field research techniques, including questionnaires, personal interviews, and researcher observation and participation. To capture as many perspectives as possible, the questionnaire targeted respondents representing the full gamut of TS stakeholders, including military, government civilian, and contractor personnel at various ranks and organizational levels. Some document data were reviewed, but related findings were mostly irrelevant to this research.

Assumptions

Two key assumptions were made regarding this study: 1) a void existed with respect to formally identifying process improvement activities or initiatives associated with the TS program; and 2) no such enterprise-wide study with similar focus had been accomplished to date.

Limitations

The research conducted was qualitative in nature and involved personal perspectives, opinions, and interpretation. The researcher attempted to limit bias through the use of semi-structured lines of inquiry. Further attempts to limit bias were made in the coding methodology used during data analysis. The researcher acknowledges that total avoidance of bias may not have been achieved.

Implications

This study provides insight to decision makers about the status of the TS program from a process improvement standpoint. It comprises what the researcher believes to be an unprecedented look across the TS enterprise for prospective process improvement initiatives. Hence, the results of this research serve as a useful tool for fostering discussion of process improvement within the TS community and can be used to guide the pursuit and implementation of improvement initiatives.

II. Literature Review

Chapter Overview

The TS program came to being as a direct result of quality-related problems experienced by the KC-135 user community. Hence, the chapter begins by providing a definition of the term *quality* as used in the context of this research. It then explains the differentiation between customer and provider perspectives of quality and discusses where and how gaps between the two can occur and potential ramifications of such gaps. Next, the chapter discusses various process improvement techniques and philosophies. This serves two purposes: first, it helps define the TS program's origins; and, second, it provides a lens through which the researcher explores and analyzes the TS program and related processes.

Problem and Context

Though literature specific to the analysis of the TS program is relatively scarce, ample literature is available pertaining to the general nature of the program's root cause—deficient quality. The vast majority of this literature is based on analysis of commercial, profit-driven companies; nevertheless, many of the findings and insights were applicable to the problem addressed in this research.

Before continuing, it is important to establish a working definition of quality. Dictionary.com (2009) defines quality as a character or trait with respect to fineness, or grade of excellence. However, in the context of this research, the definition is extended to include perspective and conformance dimensions. Accordingly, quality is defined by

the customer and entails conformance to the customer's—not the service provider's—specifications (Berry et al, 1994). Specific perspective, as well as the delineation of conformance, is critical in the analysis of service quality.

Parasuraman et al (1991) portray the contrasting perspectives of the customer and service provider in their conceptual model of service quality as shown in Figure 2. The model outlines the service process beginning with the customer's initial need for a service to eventual delivery by the service provider.

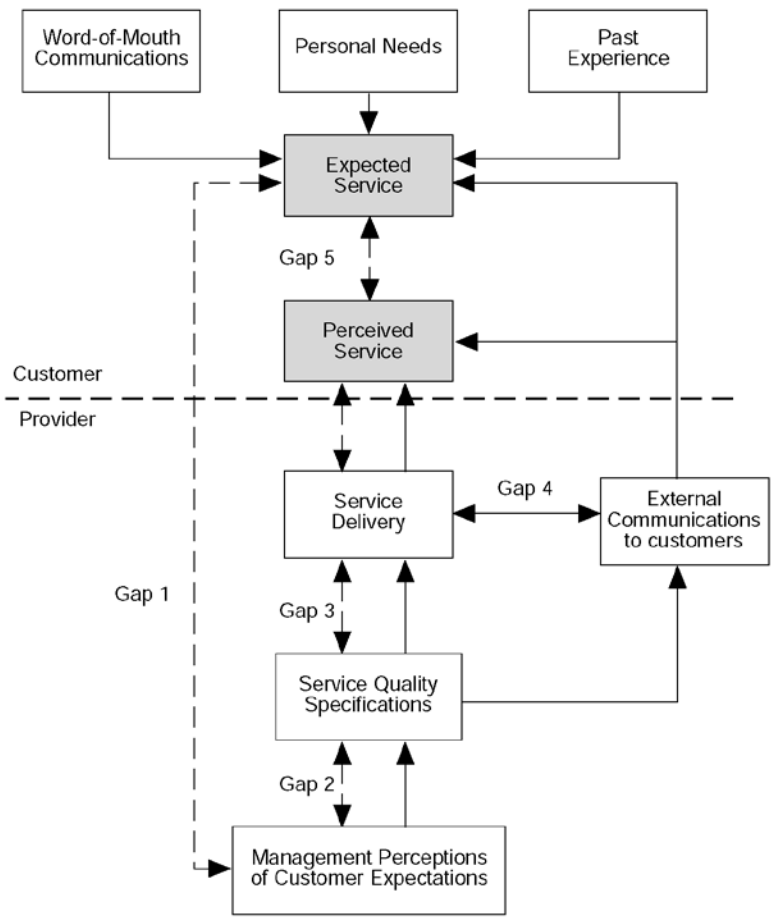

Figure 2. Service Quality Gap Model (Parasuraman et al, 1991)

The model identifies the following organizational gaps:

Gap 1: Difference between customer expectations and management perceptions of customer expectations.

Gap 2: Difference between management perceptions of customer expectations and service quality specifications.

Gap 3: Difference between service quality specifications and the service actually delivered.

Gap 4: Difference between service delivery and what is communicated about the service to customers.

Gap 5: Difference between customer expectations and perceptions of service.

The authors contend that these gaps may result in diminished service quality if left unaddressed. Though Gap 5—the difference between what the ANG expected and what they actually received in terms of the quality of aircraft from PDM—ultimately served as the impetus for the TS program, Gaps 1-4 played influential roles as well. Poor translation or miscommunication anywhere across these four gaps can impede delivery of services that customers perceive to be of high, or even acceptable, quality (Parasuraman et al, 1991).

In a related study, Parasuraman et al (1988) developed a method for assessing Gap 5 along five dimensions. These dimensions include:

1. Reliability: Ability to perform the promised service dependably and accurately.
2. Responsiveness: Willingness to help customers and provide prompt service.
3. Assurance: Knowledge and courtesy of employees and their ability to inspire trust and confidence.
4. Empathy: Caring, individualized attention the firm provides its customers.
5. Tangibles: Appearance of physical facilities, equipment, personnel and communication materials.

In a survey of more than 1,900 customers of five large, well-known American companies, reliability garnered the highest level of importance among these five dimensions for judging service quality (Parasuraman et al, 1991; Berry et al, 1994). Reliability was also identified as the core of quality service based on the findings of a ten-year study of service quality in America (Berry et al, 1994). It is fitting, then, that reliability was at the core of the quality issues experienced by the ANG, ultimately driving them to challenge existing PDM processes.

Business Process Reengineering

The changes made to the KC-135 PDM process as a result of the ANG's dissatisfaction with the reliability and, hence, quality of the services provided by the SORs can be considered a case of business process reengineering (BPR). According to Simpson et al (1999), BPR is a way of radically changing the way processes are carried out in organizations. Others define BPR as a fundamental rethinking and radical redesign of business processes and radical operational changes made to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed (Hammer and Champy, 1993; O'Neill and Sohal, 1998). Regardless of definition, the methodology used in BPR is described fairly consistently throughout the literature.

In an article on Air Force Smart Operations for the 21st Century, Antoline and Green (2009) provide the following BPR methodology:

1. Envision New Process
2. Initiating Change
3. Process Diagnosis
4. Process Redesign
5. Implementation
6. Process Monitoring

Chan and Peel (1998) classify the motivation for BPR into two categories: internal and external. Internal factors involve pressures from within an organization such as a need to reduce cost, increase efficiency, or improve quality. External factors, on the other hand, involve pressures from outside an organization such as customers, competitors, governmental regulations, or political pressures. It can be argued that both internal and external factors contributed to the BPR efforts associated with the TS program.

As this research focused more so on continued process improvement than what had already occurred through BPR, the literature review encompassed improvement initiatives not readily apparent in the TS literature. Areas researched include numerous other methods or techniques, like BPR, aimed at improving processes or operations, such as lean, Six Sigma, standardization, benchmarking, and partnering.

Lean

As mentioned in the previous chapter, ANG maintenance personnel at one point were spending an average of 52 days performing acceptance inspections on aircraft returning from PDM. Much of this time was spent reworking or re-accomplishing maintenance actions that were either overlooked or done incorrectly by personnel at the various PDM facilities. Clearly, the product was not meeting the needs of the customer.

Womack and Jones (2003) define waste as any human activity which absorbs resources but creates no value. Applying this definition to the ANG scenario, two instances of waste emerge: 1) mistakes, or defects, requiring rectification, and 2) not providing precisely what the customer wants or needs. Accordingly, these types of waste

are included in the authors' complete list as shown below:

- Mistakes that require rectification.
- Production of items no one wants so that inventories and remaindered goods pile up.
- Processing steps that aren't actually needed.
- Movement of employees and/or goods from one place to another without any purpose.
- Groups of people in a downstream activity standing around waiting because an upstream activity has not delivered on time.
- Goods and services that don't meet the needs of the customer.

Additionally, Alukal (2006a) identifies another type of waste as not fully tapping into employees' experience, knowledge, creativity, and skills.

Lean, or lean thinking, attempts to eliminate waste and provide precisely what the customer wants. An important first step in lean thinking is to specify value. In line with the previous discussion of the service gap model, Womack and Jones (2003) explain that value can only be defined by the customer. The provider, on the other hand, creates value. In the case of the TS program, it can be argued that the introduction of TS inspectors into the PDM process goes against lean thinking. After all, the PDM SORs already had a quality assurance function in their process prior to the inclusion of TS inspections. Hence, what TS did was incorporate another set of eyes, essentially adding processing steps that some may argue weren't needed or didn't add value.

On the contrary, however, it can be argued that, for whatever reason, the organic quality assurance function did not work, as evidenced by deficient quality and subsequent downtimes. Furthermore, sending owning unit personnel to the PDM facilities to conduct TS inspections allows the customer to clearly specify its value and communicate it directly to the provider—precisely what the first step in lean thinking aims to do.

Womack and Jones (2003) identify the other steps associated with lean thinking as identifying the value stream, flow, pull, and perfection. The authors define the value stream as the set of all specific actions required to bring a product through the three critical management tasks of any business, specifically the problem-solving task, information management task, and physical transformation task. The authors express a need for a voluntary alliance to be formed between all stakeholders, including the customer and provider, to monitor, assess, and improve the value stream over the life of the product or service.

Critical to this alliance is the transparency of processes and information. In a comparative study of lean production and quality commitment in two Korean auto firms, Lee and Peccei (2006) identify information sharing and teamwork as key traits of a "high-lean" organization. Information sharing and teamwork represent channels for providing transparency and are discussed in greater detail in the inter-organizational relationships section of this chapter.

Transparency is also critical to perfection, the fifth and final step in lean thinking. Womack and Jones (2003) contend transparency is perhaps the greatest contributing factor to perfection. The authors assert that since all stakeholders in a lean system can see everything, it's easier to identify ways to create value. However, Smith (2003) warns of variability being an impediment to transparency. Variability can prevent the alliance from seeing and assessing what is going on in the value stream and/or core processes of a business. Though within the lean toolbox, several methods exist to address variability,

doing so lies at the core of another process improvement methodology known as Six Sigma.

Six Sigma

Six Sigma is a methodology steeped in statistical process control. According to Goldsby and Martichenko (2005), Six Sigma attempts to identify and eradicate variability in processes. In comparison to lean, it is arguably a more structured and resource-intensive process improvement technique. Six Sigma involves a significant amount of training, where, like in the martial arts, individuals earn different belts depending on their experience and expertise. For example, the more advanced practitioners are referred to as black belts.

Central to the Six Sigma methodology is the Define-Measure-Analyze-Improve-Control (DMAIC) model (Goldsby and Martichenko, 2005). This model is used by trained Six Sigma experts in the identification and elimination of variability. Antoline and Green (2009) explain that the DMAIC model is to be used when an existing process or product is not satisfying the needs of the customer.

The ultimate goal of Six Sigma is to reduce variability and/or errors, as the name implies, to the six sigma level. Goldsby and Martichenko (2005) describe this as achieving Six Sigma quality, which translates statistically to 3.4 defects per million opportunities. Since it is a statistics-driven methodology, Goldsby (2009) explains that Six Sigma is best used in complex cases. He asserts that in such complex or political climates, using quantitative justification provided by Six Sigma may be more successful in achieving resolution than relying on more qualitative measures, where bias is more

likely to appear. While Six Sigma relies on statistical process control to abate variability, Smith (2003) purports another, perhaps less rigorous, way to minimize variability is through standardization.

Standardization

According to Goldsby and Martichenko (2005), standardizing work is not intended to turn employees into “mindless robots.” Rather, they contend standardization aims to identify the best way to complete a task, share the knowledge, and continuously improve the standard. Wüllenweber et al (2008) define the objective of standardization as making process activities transparent and achieving uniformity of process activities across the value chain and across firm boundaries. Considerable support was found in the literature supporting the notion that such process standardization is desirable (Wüllenweber et al, 2008; Manrodt and Vitasek, 2004). Ramakumar and Cooper (2004) go a step further in their assertion that process standardization is critical to achieving operational excellence and profitability.

As it applies to a production, manufacturing, or supply chain setting, process standardization is pursued in an effort to improve operational performance, reduce costs by decreasing process errors, facilitate communication, and/or leverage expert knowledge (Wüllenweber et al, 2008). Goldsby and Martichenko (2005) provide a model, known as SIMPOC (supplier-inputs-measurement-procedure-outputs-customers), that organizations can use to facilitate the identification and documentation of standardized processes. Forming the foundation of the SIMPOC model are the following questions, the answers to which guide the formulation of standard processes:

Supplier:	Who supplies the inputs for the process?
Inputs:	What are the inputs required for the process? This may include material, people, or information.
Measurement:	How do we measure the process to ensure success?
Procedure:	What are the procedures for the process? This includes documenting the process steps and the timing of each step.
Outputs:	What are the expected outputs of the process? These can include actual products, information, or documentation.
Customers:	Who are the customers of the process and what do they expect?

Once processes are standardized, the next challenge is to isolate the best practice and implement it throughout the organization (Goldsby and Martichenko, 2005). It should be noted, however, that best practices do not necessarily equate to the best possible way, or even the right way, a task or process can be performed. Goldsby and Martichenko (2005) purport best practices merely reflect the best that can be done at a particular point in time. Rather than be viewed as an end state, a best practice represents a beginning state—a launch point from which to pursue continuous improvement.

Sometimes best practices are found outside an organization. In these cases, the benefits can still be enjoyed by an organization through efforts such as benchmarking.

Benchmarking

Simpson et al (1999) offer the following as a definition for benchmarking: a systematic process of continuously measuring and comparing an organization's business process against business process leaders anywhere in the world to gain information which will help the organization take action to improve its performance. The key feature of benchmarking, as mentioned in its definition, is accessing other organizations to glean

best practices. Once benchmarked, processes can be improved further by the adopting organization; in fact, they can be improved to a point where they become superior to that of the original process.

As mentioned previously, the TS program was named an Air Force Best Practice and has since been adopted by the F-16 depot line at OO-ALC. Part of this research effort looked at what had been done at OO-ALC in terms of process improvement since benchmarking the program.

In a similar vein to benchmarking, cooperative inter-organizational relationships, such as partnerships, allow participating organizations to access and leverage knowledge, skills, and ideas beyond the scope of their respective boundaries (Mohr and Spekman, 1994).

Inter-organizational Relationships

It is a belief of the researcher that much of the success experienced by TS participants can be accredited to the existence of healthy, functional inter-organizational relationships (IORs) brought about by the implementation of the TS program. Hence, this portion of the literature review concentrates on IOR characteristics, including why organizations enter into such relationships and the types of attributes critical to their success. To meet the intent of the research, emphasis is given to the identification of ways to improve and sustain successful IORs.

The literature contains myriad reasons why organizations enter into IORs. Knemeyer and Murphy (2005) explain that organizations enter into IORs for several reasons, including the following:

- To gain the advantages of vertical integration while still maintaining independence;
- To take advantage of "best in class" expertise;
- To achieve service improvements; and
- To gain operational efficiencies.

The authors also describe a partnership model that includes various drivers and facilitators they contend must be present for a partnership, or IOR, to succeed. The drivers represent expected benefits of partnering, including improvement in asset and/or cost efficiencies and improved customer service.

In the case of the TS program, it is not so much a matter of what drove the determination of the various TS stakeholders to enter into IORs with each other that is important to study and understand. Many, if not all, of these stakeholders would be engaged in similar IORs regardless of the existence of the TS program. Hence, it is more a matter of the attributes necessary for IORs to function, flourish, and experience sustained success that is of importance and warrants further study and understanding. Mohr and Spekman (1994) identified the following attributes as being significant in predicting the success of partnerships:

- Coordination
- Commitment
- Trust
- Communication quality
- Information sharing
- Participation
- Joint problem solving
- Avoiding severe resolution tactics

Their research further suggests that the greater the amount of these attributes present, the greater the likelihood the partnership will prevail. It follows, then, that sustained IOR success is dependent on the relative amount of each attribute that remains present in the relationship.

Ring and Van de Ven (1994) identify turnover as another significant attribute to the success of IORs. They propose that if the individuals engaged in an IOR do not change, personal relationships increasingly supplement role relationships as the IOR develops. As a complete void of turnover rarely occurs in business, the authors recommend formalization, or documentation, of the IOR and associated processes to assure continuity. However, they are quick to warn against excessive formal structuring of cooperative IORs as doing so is likely to lead to the dissolution of the relationship. In a related study, excessive formalization and monitoring of terms of IORs led to conflict and loss of trust among participants (Van de Ven and Walker, 1984).

In the context of the TS program, employee turnover is important to mention for several reasons. First, turnover among ANG, AFRC, government civilian, and contractor personnel is arguably lower as compared to their active duty military counterparts. Second, it is the contention of the researcher that this relative lack of turnover among TS participants is a key ingredient to the success of the program. Finally, as the literature purports, it is the converse—the relative profusion of turnover among active duty units—that may hinder any sustained success should AMC decide to adopt the TS process.

Synthesis

The purpose of this chapter was to review literature to set the stage and develop an analysis construct for the research effort. As quality spurred the inception of the TS program, the term was defined and delineated with respect to the context of the research. The researcher discussed the differentiation between customer and service provider perspectives of quality, as well as the gaps that may exist between the two and elsewhere

according to the service gap model. Also included in the chapter was a description of various process improvement techniques that can be employed to bridge these gaps.

It should be noted that, in the context of this research, the point of process improvement—specifically, *continuous* process improvement—is to achieve operational excellence which, in this case, includes improved quality regardless of technique used. The researcher used these techniques as a framework to guide the analysis of the TS program and its associated processes. The following chapter takes a closer look at the particular methodology employed in this analysis.

III. Methodology

Chapter Overview

This chapter describes the methodology used in this study. The literature tends to agree that the types of methodologies available to the researcher include quantitative, qualitative, or a combination of the two (Babbie, 2005; Leedy and Ormrod, 2005; Creswell, 2003; Miles and Huberman, 1994). The first section of this chapter describes the process used by the researcher in determining the methodology most suitable for this particular research. Subsequent sections discuss the specific research and data collection methods.

Determination of Methodology

In determining the research methodology best suited for this particular effort, the researcher used decision tools offered by both Creswell (2003) and Leedy and Ormrod (2005). In each case, these tools were used as templates to which information relative to the research effort was compared. Based on these comparisons, the researcher was able to clearly identify a methodology. In the case of Creswell, the information contained in Table 1 was used as a template.

Table 1. Qualitative, Quantitative, and Mixed Methods Procedures

Quantitative	Qualitative	Mixed Methods
Predetermined Instrument-based questions Performance data, attitude data, observational data, and census data Statistical analysis	Emerging methods Open-ended questions Interview data, observation data, document data, and audiovisual data Text and image analysis	Both predetermined and emerging methods Both open- and closed-ended questions Multiple forms of data Statistical and text analysis

The information shown in Table 2 was used as a template for Leedy and Ormrod. While known information relative to the research project was compared with the information in the Creswell table, the researcher had to address specific questions for that of Leedy and Ormrod.

Table 2. Characteristics of Quantitative and Qualitative Research Methodologies

Question	Quantitative	Qualitative
What is the purpose of the research?	• To explain and predict • To confirm / validate • To test theory	• To describe and explain • To explore and interpret • To build theory
What is the nature of the research process?	• Focused • Known variables • Established guidelines • Predetermined methods • Somewhat context-free • Detached view	• Holistic • Unknown • Flexible guidelines • Emergent methods • Context-bound • Personal view
What are the data like, and how are they collected?	• Numeric data • Representative, large sample • Standard instruments	• Textual and/or image-based data • Informative, small sample • Semi-structured, non-standardized observations and interviews
How are data analyzed to determine their meaning?	• Statistical analysis • Stress on objectivity • Deductive reasoning	• Search for themes and categories • Acknowledgement that analysis is subjective or potentially biased • Inductive reasoning
How are the findings communicated?	• Numbers • Statistics, aggregated data • Formal voice, scientific style	• Words • Narratives, individual quotes • Personal voice, literary style

In reference to the first question regarding research purpose, Leedy and Ormrod (2005) explain that qualitative researchers seek a better understanding of complex situations; their work is often exploratory in nature; and they may use their findings to create theory. This corresponds well to the purpose of the TS-related study, as it sought to explore TS processes and identify areas for potential improvement.

The next question deals with process. At the outset, the research process wasn't exactly known. The process developed over time, as evidenced by the use of both an initial and follow-up questionnaire to collect data. Creswell (2003) supports this by explaining that, in qualitative research, questions may change and be refined as the researcher learns precisely what to ask. Furthermore, Leedy and Ormrod (2005) describe a qualitative process as one where the researcher enters a setting with an open mind, prepared to immerse in the situation and interact with stakeholders. All of this aligns well with what the researcher experienced during this research effort.

The third question involves types of data and methods of collection. The data in this research were primarily textual in nature. Leedy and Ormrod (2005) claim, to some extent, that data dictate the research method. Based on this contention alone, the data favor a qualitative methodology. To be sure, the researcher compared the data collection methods to the tabulated characteristics. The data in this research effort were collected through semi-structured inquiries conducted via written questionnaires and personal interviews encompassing a relatively small, yet informative sample. This, too, favored a qualitative methodology. Incidentally, data collection methods also included document and observation data. More detailed discussion regarding data collection is provided later

in this chapter.

The fourth question pertains to data analysis and the derivation of meaning from such data. To begin with, the majority of the data were based on individual responses. Hence, bias was introduced into the data. As for data analysis, this research effort involved the use of matrix displays and coding methodology. The use of matrices served to organize the data to ease the task of review and analysis, while coding allowed for the identification of themes or patterns within the data.

Finally, in terms of how the findings would be communicated, the answer was unequivocally through the use of words. No numeric data were reviewed in the course of research, nor were any statistical data included in the findings; however, consideration of quantitative data is recommended for future research. In all, qualitative research methodology was determined to be best suited for this effort. Subsequent sections in this chapter address specific considerations given to research and data collection methods.

Research Methods

The literature is varied in its labeling of the act or method for conducting research. Creswell (2003) uses “strategies,” “procedures,” and “approaches” interchangeably. Babbie (2005), on the other hand, uses “paradigms” and “methods.” Leedy and Ormrod (2005) use “methods” as well, but alternate with “designs” and even “methodologies.” To avoid confusion in the context of this study, *method* is used for the specific acts of conducting research, while *methodology* refers to the qualitative nature of research performed.

While the labeling of research methods varies, the literature is fairly consistent as

to the types of qualitative research methods available to the researcher. According to Leedy and Ormrod (2005), some of the types of methods and their respective purposes include:

• Case study:	To understand one person or situation in great depth
• Ethnography:	To understand how behaviors reflect the culture of a group
• Phenomenological study:	To understand an experience from the participants' point of view
• Grounded theory:	To derive a theory from data collected in a natural setting

Based on the research objective, as well as the types of data available and manner in which data were to be collected and analyzed, the researcher determined the most suitable research method was case study. Since the research focused wholly on the TS program, and this type of research of the program and its associated processes is presumably unprecedented, the specific research method is best described as an exploratory single-case study (Yin, 2003).

Data Collection Methods

According to Strauss and Corbin (1990), the most common sources of qualitative data are interviews and observations. Creswell (2003) offers open-ended questions, audiovisual data, document data, and text and image analysis as additional sources of qualitative data. The primary data collection methods used in this research effort were questionnaires and interviews.

Two separate questionnaires were utilized. An initial questionnaire was administered via e-mail followed by a more robust questionnaire used during personal interviews. Both included open-ended questions. The reason for multiple questionnaires was straightforward. Having been unfamiliar with TS processes, the researcher gleaned

considerable insight from the initial questionnaire to gage the line of inquiry of the more robust and in-depth follow-up questionnaire administered via personal interview. The questions used in the initial questionnaire and follow-up interview are contained in Tables 3 and 4, respectively.

Table 3. Initial Questionnaire

Question 1:
Do you think Operation Team Spirit adds value to the KC-135 programmed depot maintenance process? If so, how? Please elaborate.
Question 2:
Do you think the TS program adds value to the post-PDM home station acceptance inspection process? If so, how? Please elaborate.
Question 3:
Can you think of any enhancements that can be made to the current TS program to improve its effectiveness and/or efficiency? If so, please describe these enhancements and their potential impacts.

Table 4. Follow-up Interview Questionnaire

Question 1:
What is the greatest benefit of the Team Spirit program?
Question 2:
What is the primary driver leading to this benefit?
Question 3:
How is TS-related info shared between your unit and other units in the TS enterprise?
Question 4:
Is there a single process owner for TS? If so, whom / what organization?
Question 5:
Is there a team specifically devoted to Team Spirit process improvement initiatives?
Question 6:
Is there a mechanism/forum in place where TS process-related issues are discussed?
Question 7:
What is the long-term goal(s) of Team Spirit? Is there an end state? If so, what is it?
Question 8:
Are there metrics used to track the performance of the Team Spirit program? If so, what are they; how often are they reviewed; and by whom?
Question 9:
Are the metrics in line with the long-term goal(s) of the program?
Question 10:
What is the biggest void/area in most need of improvement related to the TS program?

In addition to the personal interviews conducted pertaining to the KC-135 TS program, the researcher utilized a similar line of questioning to gather data regarding the F-16 TS program. The interview was conducted over the telephone with a representative from OO-ALC who managed the program for several years, including when it was first adopted. The line of inquiry focused on key areas of the F-16 program as they compared to related findings associated with the KC-135 program.

Data were also collected through observation. The researcher was able to observe a number of TS events. For example, the researcher observed as a team of maintenance personnel from an ANG KC-135 unit participated in a TS inspection on one of their aircraft undergoing PDM at OC-ALC. Included in the observation were the initial kick-off meeting, the actual TS inspection, and the end-of-day out brief where all findings were discussed with the depot maintenance team. The researcher also attended the Spring 2009 KC-135 Product Improvement Working Group (PIWG) in Oklahoma City. During this time, the researcher observed the structure and proceedings of the various sub-meetings as well as the interactions of stakeholders as agenda items pertaining to TS were discussed.

These data collection methods were used for a number of reasons. First, literature pertaining to TS processes was scarce. A considerable amount of literature could be found regarding the program itself, but very little, if any, could be found addressing specific processes or associated improvement efforts; hence, document data pertinent to the research were virtually non-existent.

Second, and perhaps most important, the researcher wanted to get as much information as possible from the personnel most intimate with the processes—those involved not only at the management level, but those who actually participated in TS inspections. To do this required targeting specific personnel for the questionnaires and interviews. As TS is a quality-focused program, the researcher chose to target the quality assurance superintendents at several ANG and AFRC units, as well as maintenance personnel who had participated in TS inspections before. As for the PDM locations, the researcher interviewed personnel on the production floor and production supervision at the organic site and those in management positions at the contract sites.

Finally, to limit bias as much as possible in the data, the researcher collected data by observing many of the TS processes as they occurred and participating in various TS-related activities.

Summary

This chapter described the research methodology and specific research and data collection methods used in this effort. Included in this description were the processes used in the determination of each. Due to the type of data needed to satisfy the research objective, semi-structured inquiries were selected as the primary means of data collection. Based on the qualitative nature of the research, the researcher followed an incremental approach to inquiry by first administering a written questionnaire; then, using the responses from this initial questionnaire, the researcher refined the questions and incorporated a more robust line of inquiry into the follow-up interviews. The next section takes a closer look at the data analysis techniques and associated findings.

IV. Results and Analysis

Introduction

The purpose of this chapter is to present and analyze the data collected through the various methods previously discussed. The primary data collection methods employed consisted of an initial questionnaire and a follow-up interview. In each case, the researcher used matrix displays (Miles and Huberman, 1994) to facilitate the analysis of respondent data. Once the matrices were populated with the data, the researcher reviewed the contents and proceeded to iteratively code the data (Creswell, 2003).

The researcher began by reviewing the entire set of responses. Next, each response was reviewed using greater scrutiny and key words or phrases were highlighted. Similar key words or phrases were combined into clusters. Using these clusters as column headings in an Excel spreadsheet, the researcher tracked the number of respective cluster occurrences in the response data.

Miles and Huberman (1994) recommend counting as a means to identify themes or patterns when analyzing qualitative data. The authors explain that a key benefit of using this method is to protect against bias. Applying this counting method, the researcher was able to determine the relative significance of the individual clusters. Next, the clusters were reviewed again for interdependencies or similarities and further refined into distinct categories. These categories summarize the overall results of the respective data collection methods.

The researcher also conducted a telephone interview with a representative from

OO-ALC to collect data associated with the F-16 depot line. Data were also collected through personal observation and participation. Some coding was done to organize the data and, ultimately, these coded data have been tabulated and will be discussed accordingly.

Demographics

The researcher targeted data sources representing the full gamut of TS participants, including AFMC, AFRC, AMC, ANG, and contractor personnel at various ranks and organizational levels. This was done to capture as many different perspectives as possible, as well as reduce bias in the results. The majority of the respondents represented the customer, particularly the ANG. As originator of the TS program, the ANG serves as the primary champion of the program and is no stranger to process improvement. Hence, significantly more respondents were chosen among ANG field units than any other demographic. The demographics of respondents for the questionnaire and interview are reflected in Figure 3.

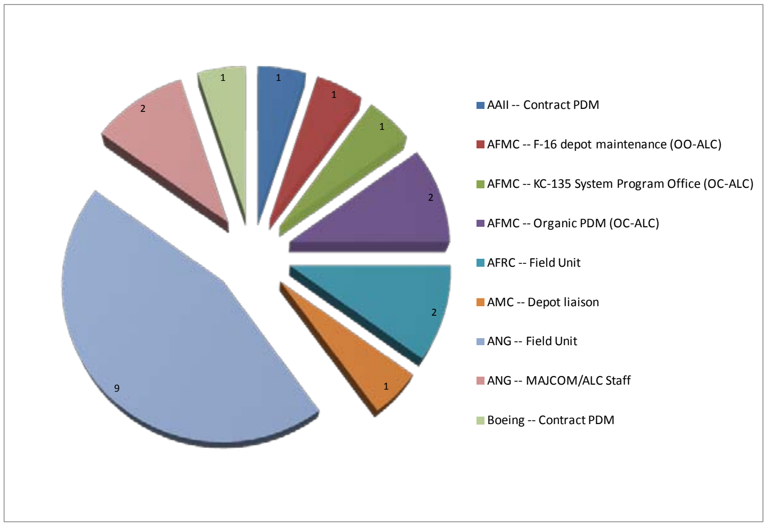

Figure 3. Demographics of Respondents

Initial Questionnaire

As the researcher had very little knowledge of the TS program, an initial questionnaire was utilized to gather information in order to better familiarize the researcher with the topic and facilitate the development of a follow-on, more detailed line of inquiry. Creswell (2003) suggests a similar approach where an initial survey is used to generalize results and is followed by detailed, open-ended interviews to garner more specific information from respondents. Leedy and Ormrod (2005) further support this approach, stating qualitative research is more holistic or emergent than quantitative methods. The authors contend the research focus, design, and measurement instruments can develop and change throughout the course of a research effort.

What did not change during this particular research effort were the target respondents. From the outset, the researcher aimed to target individuals most intimate with the TS program, namely those personnel at management levels who possessed the greatest amount of “corporate knowledge” as well as those who actively participated in the program and associated processes.

The initial questionnaire included three broad, open-ended questions. A total of ten responses were collected. Four of which were received from quality assurance superintendents from ANG KC-135 field units; five were from maintenance personnel from ANG and AFRC field units who had participated in TS inspections at various PDM locations; and one was from a management-level representative from one of the two contract PDM locations. Table 5 shows the results of the first two questions pertaining to

the perceived benefits of the TS program. The tabulated data represent the responses after clustering was applied.

The relative significance of these clusters based on the overall counts is shown in Figure 4. It is apparent from the count data that increased information and/or knowledge sharing as well as decreased aircraft downtimes were considered the two most significant benefits of the TS program by the questionnaire respondents.

Table 5. Initial Questionnaire Results: Benefits of TS Program (clustered)

Benefits of TS Program	Number of Respondents Mentioning Item (N=10)
Increased aircraft availability	5
Decreased animosity between owning unit and PDM SORs	1
Decreased costs	2
Increased customer confidence	5
Reduced defects or incidents of rework	4
Decreased acceptance inspection length and/or associated downtime	13
Increased information / knowledge sharing	14
Increased joint problem solving	2
More learning opportunities	4
Improved maintenance accountability	1
Enhanced mission effectiveness	2
Improved morale	3
Increased networking / improved communication opportunities	5
Improved visibility into PDM processes	6
Improved product / service quality	3
Increased reliability in PDM product	3
Improved teamwork	5
Better understanding of customer expectations	1
Improved workmanship	2
Total	81

After examining the data clusters for similarities and interdependencies, two distinct categories emerged within which each cluster could be organized: *Quality* and *Teaming*. Within the Quality category, the researcher included the clusters pertaining to quality itself, as well as factors necessary to achieve increased quality—such as

decreased defects and incidents of rework—and those benefits occurring as a result of increased quality—such as decreased aircraft downtime, increased aircraft availability, and improved customer confidence. The Teaming category consisted of benefits accredited to successful partnerships or inter-organizational relationships. These included such clusters as greater information sharing, increased process visibility, better understanding of customer expectations, and improved morale.

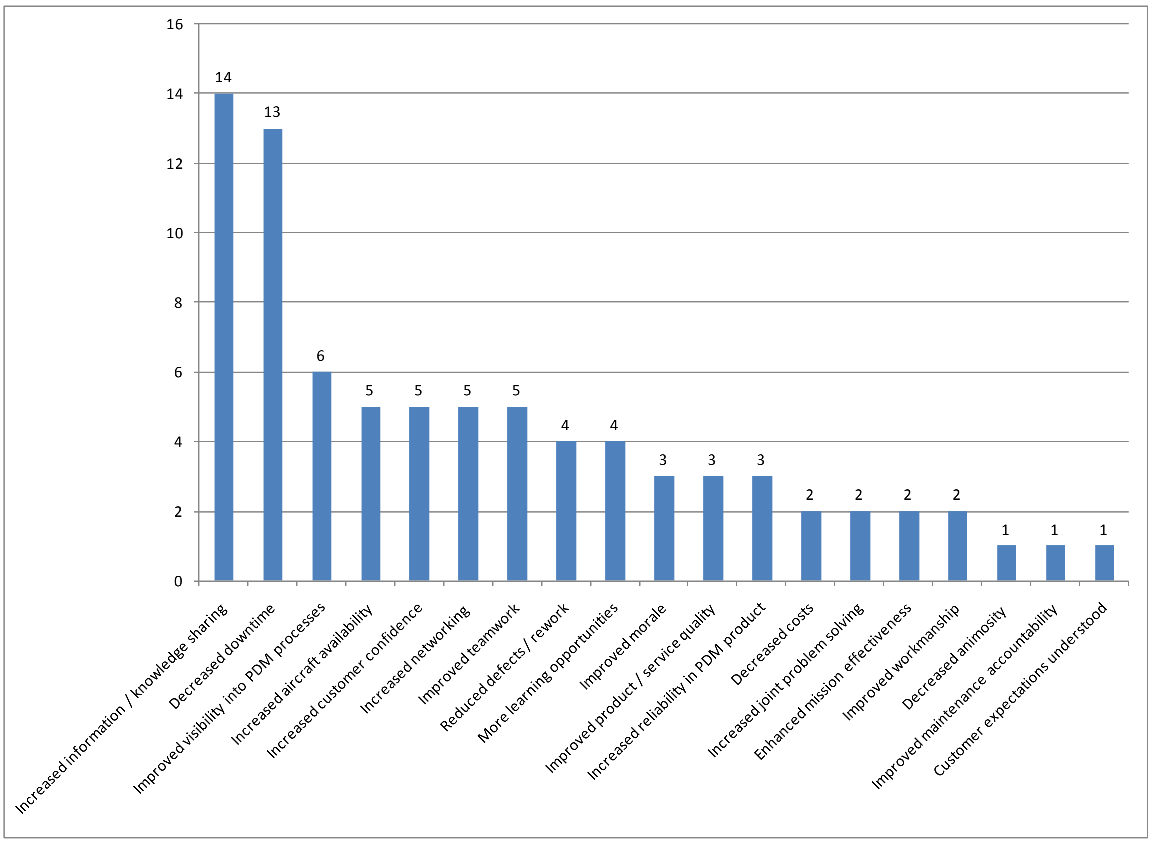

Figure 4. Questionnaire Results: Frequency of Benefit Cluster Occurrences

The initial questionnaire also requested input regarding areas of improvement. Table 6 reflects the responses after clustering was applied. Specific recommendations can be found in the raw data included in Appendix A. The relative significance of these

clusters based on total counts is shown in Figure 5. As evidenced in the clusters, the key findings regarding improvement areas involve single process ownership, process standardization, and improved communication and information sharing.

Table 6. Initial Questionnaire Results: Recommended Improvements

Recommended Areas of Improvement	Number of Respondents Mentioning Item (N=10)
Standardize processes	6
Improve pre-PDM communication	3
Improve information sharing	2
Improve post-PDM communication	2
Identify single process owner	1
Total	14

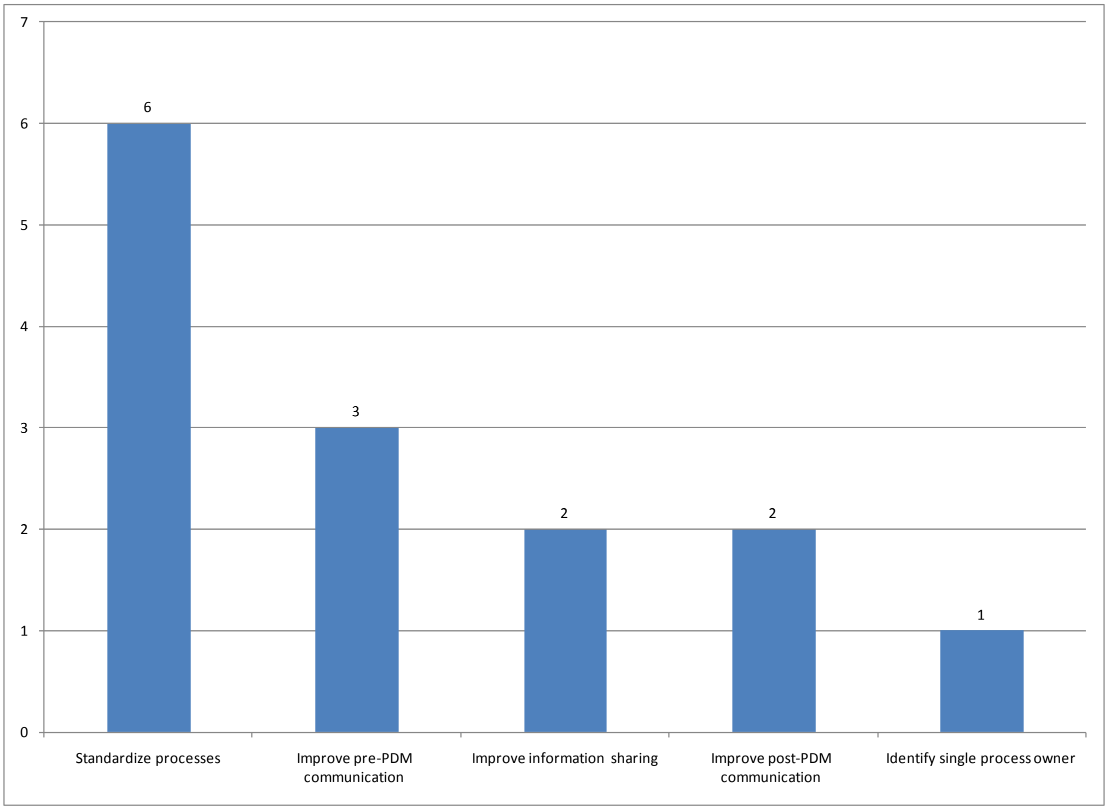

Figure 5. Questionnaire Results: Frequency of Improvement Cluster Occurrences

As mentioned earlier, the data collected from the initial questionnaire were of great use to the researcher in the development of the follow-on interview instrument; to add, these responses also helped guide the researcher in determining what TS-related activities to observe and how to approach the observations. The results of the personal interviews are discussed in the next section.

Follow-on Interview

Similar analysis methodology was applied to the set of data collected during follow-on interviews. The data were organized into matrix displays and subsequently coded. A summary of the resulting interview response clusters for Questions 1 and 10 are shown in Tables 7 and 8, respectively. Complete transcriptions of all nine interview responses are located at Appendix B. In certain cases, the clusters were then further refined into categories based on similarities and interdependencies among the response data.

Table 7. Summary of Interview Results: Question 1 (clustered)

Question 1: Benefits of TS Program	Number of Respondents Mentioning Item (N=9)
Improved quality	4
Increased customer confidence	2
Improved communication	1
Improved teaming	1
Better understanding expectations	1
Total	9

Table 8. Summary of Interview Results: Question 10 (clustered)

Question 10: Area in Most Need of Improvement	Number of Respondents Mentioning Item (N=9)
Improve communication (pre-PDM)	4
Improve communication (post-PDM)	2
Increase funding	2
Identify single process owner	2
Improve teaming	2
Improve information sharing	1
Total	13

The interviews generated a significantly larger amount of data than the initial questionnaire. This was due to the increase in number and complexity of questions posed. The response data were color coded by demographic to facilitate analysis (Creswell, 2003). Table 9 on the following page shows the results of this coding technique as applied to the results of Question 10 of the interview. Doing so provided the researcher insight into the varied perspectives of respondents based on the specific organization or organizational level they represented.

In certain cases, the response data were plotted to show the relative significance of each cluster. Figure 6 reflects the relative significance of response clusters for Question 10.

Table 9. Excerpt from Coded Interview Results

Question #	Response	Keywords / themes	Cluster
10	Ownership; single-process owner	Single process owner	Process Ownership
10	Pre-induction communication; forms/aircraft are reviewed prior to PDM induction; helps prepare battlefield; starts communication between field/PDM site	Planning; communication	Communication (pre-PDM)
10	Money…budget on depot side to cover admin expenses; post-PDM visits	Funding; communication	Communication (post-PDM); Funding
10	Communication is biggest void; funding to support post-PDM visits...helped reduce DRs; pre-induction key to smooth PDM--allows depot/field mx crosstell on individual jet basis	Planning; communication; funding	Communication (pre-PDM); Communication (post-PDM); Funding
10	TS at Tinker just restarted; must restore reputation with customer; also new people on team (turnover pains); friction between SPO and depot mx	Teamwork	Teaming
10	AMC's lack of involvement; limits funding/prioritization put on TS program	Acceptance	Teaming
10	info sharing; unsure what's being found at other sites; no database/website access	Information sharing	Information Sharing
10	Single office/team/POC with full responsibility for PDM SORs and participating wings	Single process owner	Process Ownership

ANG (Field Unit)
OC-ALC (Mx)
AMC (depot liaison at OC-ALC)
AAII
ANG (MAJCOM/ALC Staff)
OC-ALC (SPO)

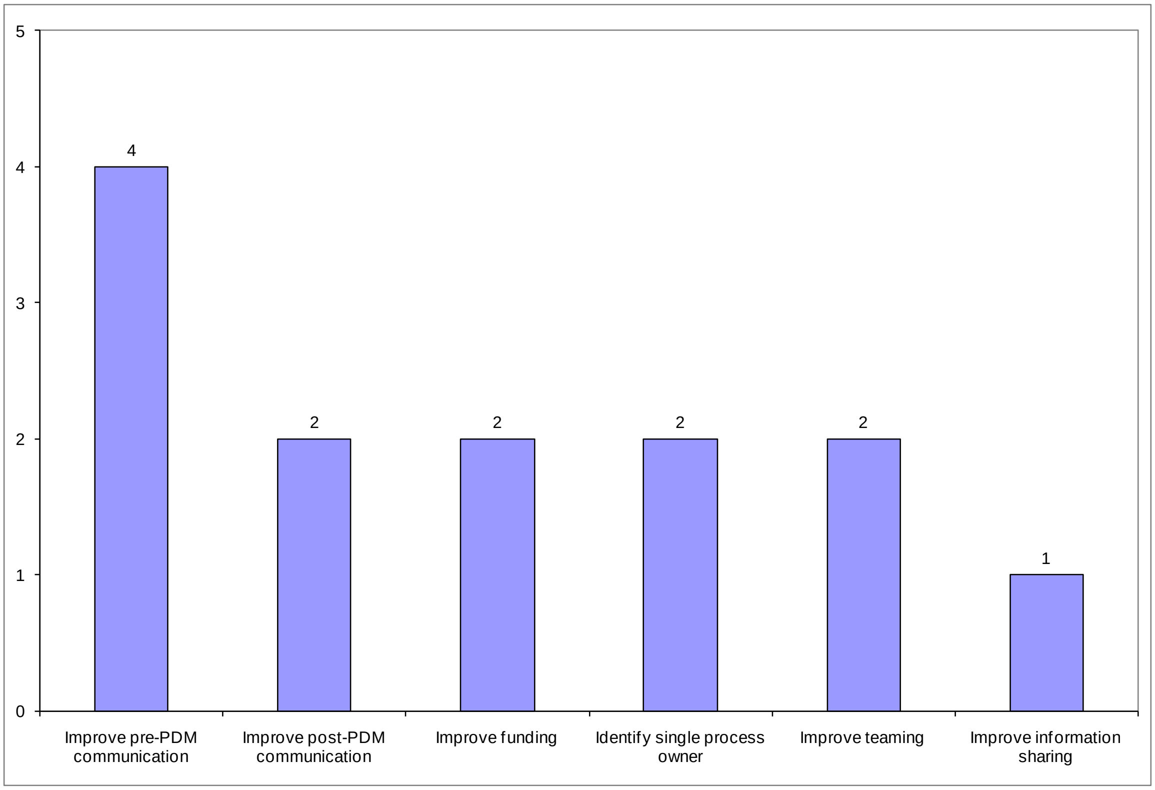

Figure 6. Interview Results: Frequency of Improvement Cluster Occurrences

The interview results produced several key findings. First, both the initial questionnaire and follow-on interview respondents agreed that the greatest benefit of the TS program related to improved quality and teaming. Specific references were made to: improved information sharing through face-to-face interactions; increased customer confidence in the SORs' ability to deliver quality products; and better understanding of customer expectations.

Another key finding pertained to how process-related information was shared among TS stakeholders. The data identified various means of sharing, including written reports, oral discussion, and a shared database or website. However, the data revealed much of this sharing occurred in isolation. For example, discussion of TS inspection findings occurred between personnel on a specific TS inspection team and representatives

from the respective SOR, but nothing was shared to any other potentially interested parties. The data also suggested that the website or database originally established as a repository of inspection data lacked currency and consistency and was difficult to access and navigate.

Lack of consistency was also apparent in the data regarding the long-term goals and associated metrics of the TS program. The majority of the interview respondents considered it to be a temporary function that would dissolve once the customers' confidence in the quality of aircraft produced by the PDM SORs was restored. Several others viewed the program as a permanent fixture that would eventually put an end to acceptance inspections performed at home station. There were no consistent metrics specified that supported either goal; however, the majority suggested the use of the existing deficiency reporting (DR) system.

One problem with using the DR system, however, is that the deficiencies reported are not necessarily unique to findings associated with PDM- or TS-related maintenance. Finally, as reflected in Figure 6, several areas were identified that were considered to be in need of improvement. Issues associated with communication—to include pre-induction planning, post-PDM visits, and sharing of inspection information and data—dominated the interview response data.

Personal Observation

Data were also collected through personal observation and participation. An initial visit to OC-ALC was conducted to observe KC-135 PDM activities and gather TS-related information. Additionally, the researcher attended a KC-135 PIWG where several

sub-meetings were observed, including the Product Standardization Working Group (PSWG), portions of both the AMC and ANG/AFRC pre-PIWG meetings, and the main PIWG session. The researcher also observed and participated in the TS inspection of an ANG aircraft undergoing PDM at OC-ALC.

Initial Visit.

Table 10 summarizes the researcher's key findings during the initial fact-finding visit to OC-ALC. During the visit, the researcher determined there was no formal process documented regarding the handling of discrepancies found during TS inspections. Though an unwritten, informal process existed, the researcher could not find evidence of a documented process pertaining to how fixes of TS inspection-related discrepancies were approved or accomplished based on expected repair cost.

Table 10. Personal Observations from Initial OC-ALC Visit

Finding	Cluster
No formal course of action regarding TSI-related fixes Lower monetary value, fixed on spot; higher value, consult SPO Process not documented/formalized	Formalization
Engine ISOs performed as part of PDM for AMC, but not ANG Acceptance inspections not standardized across ANG, AFRC units	Standardization

As these particular discrepancies were not budgeted for in the original PDM contract, the researcher suggests a formal, documented process be established for auditing and general accountability purposes. The researcher did not inquire if such a process existed at the contract PDM locations; nevertheless, once established, it is suggested that the process be standardized across all SORs.

The researcher also discovered that engine isochronal inspections were being performed concurrent to PDM on AMC aircraft but not on ANG aircraft. Instead, ANG units were performing the engine inspections at home station. In some instances, these inspections were being done immediately after aircraft returned from PDM, adding to the extensive downtimes originally reported by ANG units. The researcher contends that efficiencies—particularly as they relate to cost and aircraft availability—may be gained by having engine isochronal inspections performed concurrent to PDM. As such, the researcher suggests consideration of adopting this concurrent approach to benefit from the apparent economies of scope.

Finally, it was evident that the post-PDM acceptance inspection process was not standard across the KC-135 Total Force fleet. Previous mention is made in this report regarding the benefits of standardized processes. One of the key benefits is providing transparency, which is often a prerequisite for enabling process improvement to take place. Put simply, a process that cannot be seen cannot be fixed or improved. It is the contention of the researcher that acceptance inspections should be standardized as much as possible, particularly considering the growing maintenance and reliability concerns related to this fleet of aircraft.

Product Improvement Working Group.

The researcher documented several findings while attending the spring 2009 KC-135 PIWG. A summary of these findings is shown in Table 11. The primary areas, or clusters, observed in most need of improvement include formalization, information sharing, process ownership, and standardization.

Table 11. Personal Observations from PIWG

Finding	Cluster
PSWG has potential to serve as TS process improvement forum	Formalization
SORs struggle with accessing DR info from field	Information Sharing
PSWG needs distinct leader to keep meeting on track	Process Ownership
Inconsistent performance of acceptance inspections Noticeable friction between active and reserve units regarding TS PSWG requires more comprehensive representation DR process inconsistent; inconsistent use / interpretation	Standardization

Though not entirely focused on TS-related issues, the Product Standardization Working Group, or PSWG, did offer a forum for discussion of TS-related process improvement initiatives. However, for it to succeed as such, several changes would need to occur. First, a distinct forum leader would need to be identified, as it was not clear who led the PSWG. Also, there did not appear to be much accomplished during the course of the meeting. No actionable items were observed, and discussions often strayed from the agenda.

If the PSWG, or similar construct, were to be used as a TS-specific process-improvement or information-sharing forum, more comprehensive representation would need to occur. At a minimum, effective representation would be required from each of the three SORs, the KC-135 system program office, and the field units. *Effective* representation is meant to include individuals steeped in knowledge of the TS program and related processes, as well as experienced in process improvement methodology. In the case of the customer, a single representative from each of the using MAJCOMs

would suffice, so long as each can represent the collective voice and concern of their respective owning units in terms of issues and process-improvement initiatives.

Though a repeat finding, lack of standardization of acceptance inspections bears mention again due to the nature of its discussion during the PSWG. Based on interactions observed during the meeting, one reason why AMC does not perform acceptance inspections—or does so, but not as in-depth as the ANG—was attributed to differing interpretations of Technical Order 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*. Figure 5 contains an excerpt of this particular technical order reference as it pertains to acceptance inspections.

2.21.1 The gaining MAJCOM/unit will perform an acceptance inspection on all newly assigned aerospace vehicles and engines prior to placement into service and on all received from organic or contract depot maintenance prior to being placed in service. The gaining MAJCOM/unit may perform this inspection at the depot or an alternate location. These inspections will be of sufficient depth to determine the ability of the item to perform its designed function. Check to ensure the completeness of historical documents. Record this inspection on the appropriate documents and the appropriate MIS. The discrepancies will also be entered into the Deficiency Reporting System IAW TO 00-35D-54, USAF Deficiency Reporting and Investigating System.

Figure 7. Guidelines for Performance of Acceptance Inspections (DAF, 2006a)

The researcher acknowledges the relative vagueness regarding the depth of acceptance inspection required. Nevertheless, based on previously mentioned reasons, it is still the contention of the researcher that acceptance inspections be standardized. Incidentally, it was apparent that this differing of opinion over acceptance inspections drove the observed friction between active and reserve perspectives over the utility and value of the TS program.

Information sharing comprised the last finding observed by the researcher during the course of the PSWG. Contract SOR representatives claimed that it was difficult for

them to access post-PDM DR data. They explained that access to this data would help them significantly in further improving the quality of the aircraft produced at their PDM site. The researcher agrees with this assessment and suggests attention be given to the current DR process. Areas of focus should include consistent use by field units as there was mention of some units not reporting valid discrepancies; however, the determination of a discrepancy's *validity* was also cause for debate among PIWG attendees. Hence, varying interpretations among field units of what constitutes a valid, reportable discrepancy warrants further investigation as well.

Team Spirit Inspection.

The last activity observed by the researcher involved the TS inspection of an ANG aircraft at OC-ALC. The researcher participated in the initial kick-off meeting, actual TS inspection, and end-of-day out brief where the TS inspection team and members of the depot maintenance team discussed all related discrepancies. Table 12 outlines the key findings observed during the course of these events.

Table 12. Personal Observations of Team Spirit Inspection

Finding	Cluster
No detailed TS process documented other than existing MOU	Formalization
Standardized inspection checklist not used by TS inspection team Materials/data provided differed among PDM SORs	Standardization

The first observation involved the lack of a detailed, documented TS process. There exists an MOU between TS participants, but its contents are neither detailed nor comprehensive. For example, there is no language within the MOU pertaining to the handling of discrepancies found during TS inspections based on estimated repair costs.

Furthermore, the MOU calls for providing feedback and lessons learned following each TS “assessment,” yet no detail is given as to the specific type of information to be included or the mechanism for providing it (TMD, 2006).

Hence, it is recommended by the researcher that the TS process be formally documented in detail sufficient for continuity purposes. Care should be taken, however, to avoid excessive formal structuring of the process as the literature purports doing so may lead to the dissolution of the relationship created under the TS construct.

The remaining observations dealt with standardization. The first instance that suggested a lack of standardization involved the TS inspection checklist. It was explained to the researcher that a standardized checklist was created for use during TS inspections. However, during the observed inspection, the visiting inspectors had brought and utilized their own, unit-specific inspection checklist. The researcher suggests the implementation and consistent use of a standardized checklist among all TS participants, at all SORs.

Another instance of standardization issues involved the data provided to the inspection team upon their arrival. During the kick-off meeting, the host PDM team offered electronic access to documentation regarding previous TS findings; however, other SORs reportedly provide hard copies of such data to the teams either during the kick-off meeting or in advance of the visit to allow time for review and preparation. This process, including the type and dispersal of data, should also be standardized among SORs. Not only that, the researcher asserts that the data should be shared among all TS stakeholders as part of a formal effort where statistical and/or trend analysis can be performed to facilitate preventive maintenance and process-improvement initiatives.

Telephone Interview

The researcher interviewed a former manager of the F-16 TS program at OO-ALC. The interview was conducted after data were collected on the KC-135 program. Doing so allowed the researcher to focus the inquiry on areas where potential leveraging, or benchmarking, would be of most benefit. The results of the interview revealed both similarities and differences between the two programs.

First, in terms of similarities, the programs shared a lack of formalization and standardization of certain processes, particularly that involving approval and disposition of discrepancies identified during TS inspections. When a discrepancy is discovered during an F-16 TS inspection that is considered to be monetarily beyond the scope of the inspection, a maintenance work request (MWR) is submitted to the respective funding authority for approval and disposition instruction. When asked what the monetary threshold was that required the submittal of an MWR, the interviewee did not think one was formally identified. Further, the interviewee stated there was no formal documentation providing disposition instruction based on estimated repair costs. The same finding was revealed through the study of the KC-135 TS program. Again, for audit and general accountability purposes, the researcher asserts this particular process should be formalized and documented.

Another similarity between the two programs is the lack of any formal process improvement function. According to the interviewee, the program has not undergone any significant process improvement since it was first adopted several years ago. As in the KC-135 program, this, too, represents a shortcoming of the TS program. Significant process improvement literature exists explaining the importance and benefits of

continued assessment and monitoring of a process even after an initial improvement is put into practice. In both cases of TS implementation, evidence of *continuous* process improvement activity is lacking; hence, the researcher's contention is for the formal establishment of a team dedicated to such.

Based on the interviews, the key difference between the two TS programs was in the area of information sharing. The OO-ALC depot team responsible for the F-16 TS program maintains both a community of practice (CoP) and a database consisting of TS inspection findings. The CoP contains TS scheduling information accessible by the various F-16 field units. The database is hosted on the depot's programmed depot maintenance schedule system (PDMSS). Designated members of the F-16 depot customer service section updated the database following each TS inspection. OC-ALC maintains a similar database also utilizing PDMSS; however, the key difference between the two locations involves the sharing of the data.

While the OC-ALC team verbally announces during kick-off meetings that electronic data pertaining to previous TS findings are available to visiting TS inspection teams, the OO-ALC team provides the documented findings from the previous seven F-16 aircraft to have undergone TS as part of a binder to each field unit inspection team. According to the interviewee, doing so often streamlines the inspection process by highlighting specific areas for the teams to focus on; or, in other instances, teams avoid certain areas because they are confident the depot team has sufficiently addressed them based on the data provided.

Summary

The intent of this chapter was to analyze the data collected through various means and present the results. The qualitative research methods used encompassed a total of twenty respondents offering different perspectives of the TS program. The researcher used coding to organize the data, limit bias, and draw conclusions based on emerging patterns in the responses.

Several patterns did indeed emerge. First, in terms of the greatest benefit of the TS program, the responses are best summarized into two distinct categories: quality and teaming. Based on personal observation, the researcher agrees with this assessment.

Second, improved communication across the board, process standardization, and the identification of a single process owner were among the leading areas of improvement according to both the initial questionnaire and follow-on interview. The observation data agreed with this assessment as well, with the addition of the need to formalize processes and/or relationships.

Finally, the researcher explored benchmarking opportunities with the F-16 TS program. The one area identified that offers potential benefit to the KC-135 program involves information sharing, specifically how the F-16 team manages and distributes TS inspection findings. The researcher also identified areas in the F-16 program that are similar to that of the KC-135 in their potential need for improvement, particularly with regard to process formalization and standardization.

V. Conclusions and Recommendations

Conclusions

The primary objective of this research was to identify areas within the TS program in need of improvement. The research also aimed to provide a list of specific improvement initiatives based on data gathered through various qualitative research methods. As stated before, the material contained in the literature review served as a lens through which the researcher explored and analyzed the program and related processes. In doing so, several key findings were revealed that were either the direct result of or may benefit from process improvement.

The most significant outcome of the TS program's implementation—itself arguably a business process reengineering endeavor—was the decrease in the ANG's post-PDM acceptance inspection downtime from a staggering 52 days to a respectable 14. Not only did this boost aircraft availability by 70 percent, it garnered those responsible for creating TS the Chief of Staff Team Excellence Award and the program's designation as an Air Force Best Practice. Though this accomplishment clearly can be attributed to the improved quality of aircraft coming out of PDM, this research also identifies teaming and/or inter-organizational relationships as another crucial element to the success of the TS program.

The relationships formed by allowing direct, personal interaction between the customer and service provider, as the literature asserts and the research data support, have resulted in improved information and knowledge sharing, joint problem solving, and increased customer confidence. The researcher contends the specific inter-organizational

bonds formed between the ANG, AFRC, and the respective PDM SORs are fostered by low turnover experienced by these particular stakeholders; hence, it is of further contention that TS may not succeed as well among AMC units due to relatively high turnover among maintenance personnel.

Based on data collected through a combination of questionnaires, interviews, and personal observation, the study revealed a number of areas in need of focused improvement efforts. Responses were collected from twenty personnel representing every major stakeholder in the TS program. These data were organized, analyzed, and coded to allow patterns to emerge. In regard to potential improvement areas, the following patterns, or categories, emerged in the research data: *communication*, *standardization*, *formalization*, and *process ownership*. Some of the specific recommendations within these categories are captured below:

- Improve the timing of field unit notifications to maximize aircraft access during TS inspections;
- Establish an improved information technology based solution to house, analyze, and share TS-related findings;
- Standardize TS inspections across all SORs, including the type of data and manner in which these data are shared with field units;
- Perform engine isochronal inspections concurrently with PDM of ANG aircraft;
- Identify an overarching TS point of contact or management office to lead and monitor the entire program, to include process improvement forums;
- Formalize the TS program and related processes in a more comprehensive, detailed document than the existing MOU, to include the specific goal(s) of the program and associated metrics used to measure progress toward this goal; and
- Implement a formal continuous process improvement mechanism in order to maintain program currency and priority, while avoiding undesirable lapses.

Additional areas in need of improvement and/or recommended improvements can be found in Appendices A and B.

Recommendations for Future Research

This study relied exclusively on qualitative data. As briefly mentioned in Chapter III, it is recommended future research incorporate quantitative data as well as statistical analysis, where appropriate. However, in order for this to occur, the TS community will need to establish a process for gathering and tracking associated data. One particular area recommended for future research involves studying the impact TS may have on maintenance metrics, specifically post-PDM break rates among units that participate in TS and those that do not. Not only could this potentially further validate the existence of the program, but it also may achieve standardization by providing evidence compelling enough to garner AMC participation.

This study was limited to just one other program in its exploration of potential leveraging opportunities—the F-16 line at OO-ALC. Hence, inclusion of more programs that have either benchmarked TS or are products of related process improvement measures is recommended. Also recommended is inclusion of more data—particularly interview and observation data—pertaining to the two contractor SORs. Though interviews were conducted with individuals representing each, collecting data through additional interviews and personal observation may reveal findings of more significance.

Finally, the DR process was mentioned on a number of occasions in questionnaire responses and during interviews and observed interactions. From what the researcher gathered, it is a process laden with inefficiencies and, with that, potential opportunities for improvement. Thus, it is recommended consideration be given the DR process as a topic for future research.

Summary

It should be clear this study is not intended to downgrade the obvious success of the TS program. After all, the program has received rather prestigious accolades, including being named an Air Force Best Practice. However, best practices should not be viewed as end states (Goldsby and Martichenko, 2005). Rather, best practices serve as starting points from which to strive for improvement.

The goal of the researcher is to draw attention to an apparent void in process improvement activity surrounding the TS program. To achieve sustained success in any endeavor requires discipline in the form of *continual* monitoring, assessment, and improvement (Alukal, 2006b; Goldsby and Martichenko, 2005). *The researcher asserts that it is precisely this continuous focus on improvement that is lacking within the TS program.*

Many ideas and opportunities for improvement exist, but no formal mechanism is in place to act on them, much less identify them. The ANG and its partners within the TS enterprise could leverage the recommendations presented in this study for continued success of the TS program.

Appendix A: Initial Questionnaire Data/Results

Question #	Response	Key Terms / Themes
1	I have attended one Team Spirit to Tinker Oklahoma. From the start everyone was exceptionally professional and the workforces were excited to meet with us. In my experience this process adds value to the Programmed Depot Maintenance because we get to inspect our aircraft before it completes the inspection and repair process. Our team was afforded complete access and we inspected the aircraft with depot mechanics present to correct the defects as they were found. I also noticed a **vast exchange of information and knowledge between the Depot and Air Guard mechanics** that I feel is priceless. Everyone in our maintenance complex agrees that **Team Spirit has led to considerable improvements in the quality of aircraft delivered** since the operation has begun.	Information Exchange; knowledge exchange; increased quality
1	The Team Spirit inspection identifies PDM defects while still onsite, **relieving the maintenance burden from the home unit** and **reduces the downtime upon return to home station**, ultimately **resulting in higher aircraft availability, increasing overall mission effectiveness**. In addition to these primary benefits, it also **serves as a learning platform**. **Experiences are shared by both the Team Spirit members and the PDM personnel**. We learn from each other. A **rapport is develope**d by both sides. A **face and name is put on the PDM folks** for the unit and likewise for PDM, the o**wning unit is no longer a faceless customer**.	Reduced home station downtime; increase aircraft availability; improved mission effectiveness; learning platform; shared experiences; rapport developed; faces put to names
1	Yes, we here at the 121st throughout the Maintenance Group feel that Operation Team Spirit adds value to the KC135 PDM. This is an **excellent opportunity to deal one on one with the individuals involved in performing the depot maintenance** on your unit's aircraft. The **unit can share with the depot crew** as to the things that are found on the acceptance inspection at home station and see that those same areas are being looked at and getting addressed in the production line. This is also good timing while the aircraft is not completely closed up for representatives on the production line to **point out some of the key areas or some of the significant finds that were discovered during the PDM process**. This visit contributes immensely to r**educing the time it takes to accomplish the Acceptance Inspection once the aircraft returns to home station**. This is also a means of **developing good contacts** for the period just after returning the aircraft to the owning unit as to who to make contact with should there be an area or discrepancy of concern. It's just a good thing all the way around for both parties.	One-on-one dealings with depot mx personnel; information sharing; reduced home station down time; developing good contacts
1	Yes, it **allows ANG expertise to work its way into the depot process** thus **making the product the depots push out to the field more reliable**. Yes, it **allows younger eyes a chance to see the PDM process** first hand.	Leveraging expertise; increased reliability; visibility into processes; learning experience
1	Team Spirit definitely adds value to the KC135 PDM. It not **increases aircraft availability**, but helps with a f**ace to face understanding of the processes and procedures** that are in place for the PDM workers and **helps the PDM workers with an understanding of the owning units procedures and expectations**. It also helps with **accountability of maintenance being performed**. The PDM line workers know that field maintainers that they know and have worked with will be coming to look over their maintenance prior to picking up the aircraft, and we have noticed a **definite increase in workmanship**. It helps the field maintainers with their **accountability of maintenance** because they now have to send an aircraft into the PDM line to folks that they will have to answer to when they come in for the team spirit look over. During the Team spirit visits, If there are discrepancies found, they are usually corrected on the spot. **None of the finds are put into a acceptance inspection report that in the past has created animosity between the crews**. It has **created a true team atmosphere**. Although it appears to be a monetary cost up front to send crews to the PDM facility, the **real cost savings are not captured because many events that would have or may have occurred are caught and repaired prior to them happening**. **Preventive maintenance** says it best. It has not only really **produced a better and safer aircraft**, but the **field operators have a better perception of the product**.	Increased aircraft availability; face-to-face interaction; understanding of processes and procedures; understanding of customer expectations; mx accountability improved; increased workmanship; reduced animosity; cost avoidance; improved customer perception of quality/reliability
1	Yes. It gives us an all inclusive opportunity to **work with our depot counter parts**. By doing this, we can **become aware and take part in the inspection processes** and **hone our skills by table topping their experiences with ours**. I believe that this is a **team effort** and depot is a valued part of that team. Team Spirit allowed us to **view the overall picture of most of the processes that depot had to offer**. I believe that a **team that goes to Team Spirit needs more time to look at their aircraft** instead of four days. Overall, I had a great experience working with my counterparts.	Teamwork; increased awareness or processes; skills improved; improved process visibility; more time needed for inspections
1	Without a doubt! OTS has given the sources of repair an "insiders" look at what our USAF customers want done to their jets. Each Base is different but they all share the same sense of ownership of their jets. It is almost like dealing with corporate aircraft at times. These units know their airplanes and **Team Spirit has allowed Boeing to talk one on one with them and "understand" their individual jets**. The Pre induction part of the process gives the Air Force customer as well as Boeing **a name and face** in case of future contact needs and gives the customer a feeling that they can find out what's going on with their jet at any time. Obviously, value is added when Boeing has a chance to fix the owners squawks before it leaves our facility. Boeing stands behind our product and prides itself on customer satisfaction. Team Spirit gives us the opportunity to fix the customers requests before we deliver and **not push extra acceptance work off on our customer.**	Understanding of aircraft thru one-on-one dealings; put face to name; reduced downtime / extra work at home units
1	Yes any time you can get to **teams together that are working towards the same end results** in the long run it will improve the process. Example, the home unit use to find leaky fuel probes at the home stations after depot. **Once the PDM reps understood how we did our inspections it lead them in the right direction** and they were able to isolate the bad probes at the depots. This resulted in purging the systems of the bad probes **saving the depots time and money**. Both teams **knowing how the other works results in better product** making it a win win.	teamwork; joing problem solving; saved money; saved time; process visibility/understanding
1	I do believe that OTS adds value to the KC-135 program. It allows units to see airplane in the later phase of depot and **make sure write-ups that were sent to depot get completed**. The **unit also starts on the acceptance inspection checklist**, like checking under floorboards and cable tensions before panels are refastened. It **lets crew chiefs take a little more pride in his/her aircraft** by looking at it before paint to see the little imperfections that may or may not have been written up on a 103. it also **gives crew chief the experience of depot and how much is put into the aircraft.**	Repairs confirmed; reduced downtime at home station; learning experience; increased visibility into depot processes

2	Prior to Team Spirit, Air Guard maintenance teams had to wait until the aircraft returned from depot before they were allowed to inspect it. During our Acceptance inspection and home station checks we would **frequently find flight-critical grounding defects, correcting these discrepancies would keep the aircraft out of service for an additional two weeks to a month**. **Working with the Team Spirit managers to develop a check list, the majority of the Acceptance inspection was completed during the Team Spirit visit saving considerable down time at home station**. We were able to comply with all of the flight control inspection, travel and rigging checks, engine throttle cable rigging, leak and operationally check hydraulic components, inspect under floor boards prior to them being installed to include wing to body seals and header ducts, check all doors, hatches, and windows for operation, condition and fit, and inspect the entire aircraft skin and related hardware. These are just some of the **time extensive acceptance inspection items that were complied with during our visit to Tinker**.	decreased defects; decreased home station downtime
2	**Team Spirit members see firsthand the reliability that has been built into the overhauled product.** They take this **confidence** back to the unit, to **share to the unit's leadership**, who are the decision makers on the home station inspection process. When the unit's leadership believes in the reliability of the overhauled product they can be **confident in limiting the scope of the acceptance inspection**, and **return the aircraft to flying status as soon as possible**.	increased reliability; increased customer confidence; reduced downtime at home station; increased availability
2	Yes, by all means. As stated above, one of the key points is the **reduction of time aircraft is down for scheduled maintenance** to conduct the Acceptance Inspection. If a number of the same areas that are addressed in the Acceptance Inspection are looked at and closed up while the Team Spirit crew is visiting there **shouldn't be a need to reinspect** those areas. In most cases, the Team Spirit crew that visits the jet on its final phase of production is the same maintenance personnel that will be involved in the Acceptance Inspection and they are able to address any issues or questions that may come up at home station during the process. There is also the **additional information that the Team Spirit crew returns home with to share throughout maintenance**. Some **further details that they gained by talking to the production line personnel**, a **better insight as to how the process of PDM works,** or **learning additional details** of how some of the work accomplished on their units jet went. **The kind of information one would not have gained if the aircraft was just picked-up or delivered.**	reduced downtime; reduced rework; information sharing; knowledge sharing; increased visibility into depot processes
2	Yes, this is the greatest benefit of team spirit. It g**ets the aircraft back into the air for the "war fighter" because the inspection can be shortened** because the unit already has a **comfort level** from seeing the jet at the PDM facility.	reduced downtime; increased comfort level
2	Yes Operation Team Spirit (OTS) has **increased aircraft availability at home station**. All areas of the jet that were inspected during OTS **do not get re-inspected** during the acceptance inspection process. As earlier stated, the **Product workmanship has increased** significantly since OTS inception and **home unit members feel much more comfortable with the aircraft airworthiness**	increased aircraft availability; reduced rework; increased workmanship; increased comfort level
2	Yes. It **saves time in the inspection process at home station** with a 5 day turn time to put the aircraft back into a FMC status. The aircraft is configured in a way that it saves us time at home station. All, if not most, inspection item can be inspected at depot with the team we take with us.	reduced downtime at home station
2	Bottom line; **Defects on customer acceptance inspections have gone down** from an average of 3-5 defects PER jet to less than .5 per jet. **Acceptance time for the user has gone down** from an average of 45 days to less than a week. The **customer has a better sense of security** that the jet is up to their quality standards when it gets home because they have already looked under panels and under floors during their Team Spirit visit. They **don't have to go back and re-open** everything that used to take days of acceptance time. Many units have quit such things as acceptance Fuel High-Stands and opening areas not flight critical, while **some have stopped acceptance inspections completely**. Value? You bet!	reduced defects; reduced downtime at home station; increased security; reduced rework
2	Yes it adds great value on the home units end when it comes to doing the acceptance inspections. If the team is allowed on the jet **without causing a great deal of delay in the PDM flow** it **eliminates a lot of time spent in areas the unit doesn't have to re-inter**. it s**aves the home unit a great deal of time and gets the aircraft back in the flying schedule much sooner**.	reduced downtime; increased availability
2	Yes. By allowing our personnel to inspect prior to closing panels **saves a lot of time on acceptance inspections** and **gives the individuals a positive feeling about the wellness of the aircraft.** It also gives mechanics a chance to view the write-ups during the depot-level mx and see that those jobs are c/w. It also gives the mechanic a chance to follow up the 103 items that were submitted for depot to comply with. **Mechanics are also able to talk to depot level mechanics in reference to techniques and procedures** such as cable tensions being rigged to the high end of the plus/minus spectrum.	decreased downtime; increased comfort level; info/knowledge sharing

3	The Team Spirit/Depot personnel are true professionals; as we found discrepancies I witnessed **discussions on procedures and inspection methods to prevent them from ever happening again**. A couple of things I think would improve the completed aircraft for receiving bases would be one, to **have the engine inspections complied with at depot**. This would save considerable down time when the aircraft returns to home station. And two, **units should send their fuel cell mechanics back to depot during the fuel cell close-up and cavity checks** to **allow this portion of the Acceptance Inspection to be complied with once. Either that or remove this requirement from the Acceptance inspection**, the checks that are complied with at the depot level are detailed and annotated in the 781 series forms. **Team Spirit allows depot and guard mechanics to work together** only having to close up the aircraft once. Being able to access, inspect, and correct discrepancies at depot **saves considerable time, money, and manpower**. This program **should expand to all aircraft in our inventory.**	joint problem solving; perform engine iso at depot; perform fuel cell checks at depot or eliminate from checklist; teamwork; saved time, money, manpower; extend to all aircraft
3	**Establish funding to relieve cost burden to home unit. Develop an Air Force T.O. work card document to accomplish the inspection**, which is **periodically updated based on trend analysis of acceptance deficiency reports and Team Spirit findings. Establish a HHQ level Team Spirit POC or management office to oversee and monitor the entire program**. The Team Spirit findings are loaded into a **Boeing web database.** Unfortunately, the site is **not easily navigated and is slow to operate**. Establish on office to Extract data from this database and **develop trend analysis to be sent out to all -135 units and all PDM sites for cross tell.**	Increase funding; standardize inspection process via TO workcard; establish single POC; improve shared database; share trend analysis info with all participants
3	The one thing that seems to stick out in our mind is, more of the **process of notifying the owning unit of a good time to come to the PDM for a Team Spirit visit.** We know in Maintenance that it can be difficult to gauge when exactly the aircraft is at a point where it would be good to have the unit comb through the aircraft. If somehow there was to have a marked date in the production process where as they notified the unit and indicated for a Team to standby for the next couple day to be ready for a visit. That might at least help to prepare the unit for an upcoming visit. There is **one particular PDM location that provides a copy of the finds and fixes during the Team Spirit visit that helps to answer any of the questionable areas at home station as they are conducting the Acceptance.** That's a big help. There is also **some sights that use the same grade of Jet fuel when the are performing the High Stands for final fuel leak checks.** Which helps to alleviate the need for a "all tanks full" leak check as the start of the Home station Acceptance Inspection. **With the different grades of fuel when the jet is returned home and fueled with JP-8, then in most cases, leaks show up that wouldn't with the other grade of fuel used at their PDM location.**	Improve notification process (timing); standardize type and distribution of data related to TS findings; standardize fuel types among SORs
3	**Fund through Guard Bureau**. Ensure **Fuel cells are open for team when it arrives.** Provide someone to **go over each 103 item to ensure it was repaired properly.** Have PDM Team Spirit Rep **call home station P&S so GO-81 can be updated before aircraft is flown home.** Have someone **review all TCTOs completed during PDM with the team.** Have individual **review all engineering dispositions with the team.** Fleet leveling: The same active duty KC-135s are being literally pounded to death flying up to 1,200 hours a quarter while most of the ANG KC-135s still fly the same 300+ hours per year. We have to share the flying hours better throughout the entire 135 fleet and not just by command. Right now at Fairchild we get aircraft from the high corrosion zones. We perform the ISO inspections and discover upwards of 1,000 discrepancies per aircraft. We fly the aircraft for short time and it deploys and comes home for a 900 hour inspection in 3 months. Then it goes to Kadena, Macdill or Mildenhall and we never see it again yet one of their tired jets comes here to replace it and the process starts over and over again. Our ANG maintainers are getting beat to death working their tails off and all their hard work flys off to another AMC base. It's like there is a stick with no carrot. The bottom line is: the high corrosion jets need to come to low corrosion zones so they come to Fairchild because AMC doesn't look outside of their command. I think that Salt Lake ANG, Phoenix ANG, etc would also be good places to send these aircraft. They could replace the VERY tired active duty jets with highly reliable ANG jets and the Guard units could perform a refurbishment on the active duty jets. If this could be spread out throughout the ANG 135 community it wouldn't hurt any one ANG unit too badly and would really help the active duty in it's endeavor to meet their very high OPS tempo.	Single funding source; standardize fuel check process; assign/standardize record review process
3	The ANG has recently provided guidance to field units to **add OTS cost estimates to the aircraft 103 (Supplemental PDM requests) so the costs can be budgeted for.** This was the single point of contention for our unit since travel from Alaska can be costly. This new process will allow our unit to purchase supersaver airfare and save taxpayers a significant amount of money.	Funding
3	Yes. I would like to see **more interaction between us and the management team when it comes to items that have been found with other units and their processes.** This would mean that if we could s**ee or get feedback from depot and other units, it may mainstream maintenance practices and potentially impact the time that an aircraft is in depot.** We could be **informed of high visibility items that have been identified in past processes and correct them prior to an aircraft entering the depot process.**	Improve info/knowledge sharing between units and internally; perform rend analysis
3	**Timing** is everything. The struggle, I think all 3 SOR's have, is getting the owning units team into our PDM sites at exactly the right time. We want the jet very near completion yet we want panels, floors and doors open so the teams have access to their inspection areas. Parts, schedule delays and aircraft condition all play a part in getting the jets ready. The owning units have to make travel plans weeks ahead of time due to their travel systems so we "predict" the opportune time for them to come in and sometimes that may be a few days off from exactly the right time.	Timing; improve notification process
3	When I went to depot for Team Spirit back in Jul 07 the team at kelly, TX, was very proactive to assist us in any way they could. We **received records of discrepancies and had access to the aircraft with the station leads.** The team at TX was first rate and had a great sense of pride. I **wish we would have been there about a week earlier before they had paneled up.** But I believe **just corresponding with depot level mechanics helped speed up the acceptance process and getting us a good product.** The mx lead was very helpful and stayed in **constant contact** with us giving us updates as time passed.	Standardize data type and distribution of TS findings; timing/notification process; communication

Recommended Improvements / Areas in Need of Improvement
• Perform engine isochronal inspection at depot. • Perform fuel cell / cavity checks at either depot or home station, not both. • Develop technical order work card to accomplish TS inspection; periodically update work card based on TS findings and associated trend analysis. • Identify single POC or management office to oversee entire TS program. • Establish and manage TS findings database that is more accessible and more easily navigated than existing Boeing database. • Improve owning unit notification process (timing) to allow for maximum accessibility of aircraft. • Standardize TS inspection processes across all three SORs, including type of documentation and materials provided to incoming TS inspection team. • Assign individual(s) from PDM SORs to review all documented discrepancies with TS team to ensure compliance, including; 103s (supplemental PDM requests), time-compliant technical orders (TCTO), and engineering dispositions. • Improve sharing of TS-related information across the board —such as findings, trend analysis results, high-fail items, etc.

Appendix B: Follow-on Interview Data/Results

Question #	Response	Keywords / themes	Cluster
1	Teaming; peer-to-peer sharing; not so much learning, but on equal ground; management out of the picture	Communication; teaming	Teaming
1	Building customers' confidence in depots	Confidence	Qual
1	Improved quality	Quality	Qual
1	Customer satisfaction	Confidence	Qual
1	Increased quality	Quality	Qual
1	Increaed quality	Quality	Qual
1	PDM SOR (AAII) understanding customer expectations (on a by unit basis)	Understanding expectations; specify value	Teaming
1	quality; productivity; costs; reduction in manpower reqts--5 TSI at PDM site versus 15 at home doing acceptance insp	Quality	Qual
2	Information sharing; example of field rigger coming in to train depot riggers; no field feedback, so depot didn't even know rigging was an issue	info/expertise sharing	Teaming
2	Face-to-face interaction / communication between floor mechanics and field unit maintainers; helps all to understand "big picture"	networking/comm; info sharing	Teaming
2	Interaction opportunities w/ customer; gives everyone a warm fuzzy	networking/comm	Teaming
2	Teamwork; communication	Teaming; comm	Teaming
2	Information sharing; best practices; looking at other SORs, benchmarking…going to to all of this "one day"	Info sharing	Teaming
2	face-to-face interactions; insights into PDM process; networking	networking/comm	Teaming
2	Information sharing; PDM SOR/field unit procedures, mx philosphy, techniques; example given regarding KT lack of expertise in flight control system, had to rely on field unit expertise	Info/knowledge/skill sharing	Teaming
2	KT = info sharing/teamwork (all about working together); ALC = all this too, until strategic pause (perception is that ALC is $ hungry)	Info sharing (teaming)	Teaming
3	TS database; contains raw data; example provided that explained that Boeing PDM was experiencing high sheet metal issues/findings; so field units sent sheet metal mx personnel on TS teams	Database; example of value added (dated?)	Inconsistent
3	Rely on feedback from TS-experienced personnel; TS inbrief; plans and scheduling pre-inducion telecon (ALC does over phone; KT locations do so in person)	In-house means; isolated cases	Isolated
3	Believes a meeting occurs where PDM proccess discussed/compared between three SORs	Unknown	Unknown
3	Website; post-PDM visits, when funded	Website?	Inconsistent
3	No formal process; DRs from field; also briefing book INW; 827th manages a website (Boeing product); required userid/password	DRs, lacks consistency; database/website, lacks cor	Inconsistent
3	AIDR process (aircraft inspection deficiency reports); though lacks consistency across units, skewed data	DRs, lacks consistency	Inconsistent
3	At AAII, discrepancy summary filled out by TS inspectors reviewed and returned after inspection; TS website sharing history of PDM finds; not current; no owner	In-house means; database, lacks consistency	Isolated; inconsistent
3	After action report; formalized but not standardized	In-house means	Isolated
4	KC-135 SPO "should" do it	No overall process owner	No single process owner
4	Contractors each have one; depot has several; ANG has one; but no single overall POC	No overall process owner	No single process owner
4	No	No overall process owner	No single process owner
4	At specific locations, but not overall	No overall process owner	No single process owner
4	Each location has one, but no single POC overall	No overall process owner	No single process owner
4	No TS SPOC; SLC lead wing for landing gear, maybe lead "wing" can be established for TS	No overall process owner	No single process owner
4	one at AAII, but overall POC unknown	No overall process owner	No single process owner
4	No, but would like it to be SPO with goal to eventually roll TS into PDM contract	No overall process owner	No single process owner
5	No	None	No formal process improvement team/working group
5	PSWG; though not specifically for TS, offers opportunity for TS-related crosstell	PSWG	Formal team exists, but not TS specific
5	No; however, 564th has resident Six Sigma black belt on staff	None	No formal process improvement team/working group
5	No	None	No formal process improvement team/working group
5	No dedicated team, but individual TS POCs at each SOR location exist; per SPO, top-directed activities, little to no task autonomy	None	No formal process improvement team/working group
5	No, but mentioned before	None	No formal process improvement team/working group
5	unknown	None	No formal process improvement team/working group
5	No; but ANG has ANG/A4 policy and procedures function	In-house only	No formal process improvement team/working group

6	Product Standardization Working Group (PSWG) is supposed to serve this function	PSWG	Forum exists, but no TS specific
6	At depot, there's an "in-house" post-PDM hotwash; helps pass the word on what to look for etc.	In-house only	In-house forum only
6	No	None	No forum exists
6	Not currently; but PSWG good option	None	No forum exists
6	No forum as of yet, but that's the plan	None	No forum exists
6	At first, yes…during initiation, but no ongoing forum; due to small community, a lot of email coordination occurs…regarding everything, not just TS	In-house only	In-house forum only
6	unknown	Unknown	
6	There is among ANG--Mx Megaconference, includes all ANG units with KC-135 breakout	In-house only	In-house forum only
7	There was…but nothing currently.	None	No long term TS goals
7	TS is a temporary program; in place until customer confidence restored	Temporary	Temporary program
7	TS is temporary program; goal is not to have it--restore original PDM construct/process; TS findings may be used as criteria for eventual discontinuation	Temporary	Temporary program
7	Temporary or permanent, depending on who you talk to (customer)	Either	No long term TS goals
7	Temporary program until confidence increases to point where TS goes away; no set target or exit strategy	Temporary	Temporary program
7	Put home station QA out of business; TS serves as checks and balances for now; temporary, but not exit strategy set	Temporary	Temporary program
7	permanent program; eliminate acceptance inspections performed at home station	Permanent (replace home station acc insp)	Permanent program
7	Permanent; eliminate home station acceptance inspections; more efficient at depot	Permanent (replace home station acc insp)	Permanent program
8	ANG--no corporate goals; depot--accepted DRs, flowtime days; AMC--aircraft availability	Tailor DRs	DRs
8	It will stop when confidence restored, but no metrics identified to measure confidence	None	None
8	Nothing official, but TS findings can be tailored as such	TSI findings	TSI findings
8	TS findings reviewed at outbrief; loaded onto website; sent out via email to all OC-ALC mx personnel; AF Form 1151, confirmation of briefing receipt (required among depot mx personnel)	Tailor DRs; communicate across entire TS community, not just in house	DRs
8	DRs, but not TS-specific; no targets set; post-PDM visits INW (organic), $-dependent; unsure wrt pre-strategic pause (new guy)	Tailor DRs	DRs
8	Nothing as of now	None	None
8	Not necessarily; DRs are available, but they're not specific to TS-specific findings/metrics	Tailor DRs	DRs
8	DRs; some units apparently are not submitting their DRs…and that's a foul; skews data that can be used for trend analysis, etc.	Tailor DRs; mandate DRs	DRs
9	N/A		
9	N/A		
9	Can be, if prescribed as such		
9	No		
9	no		
9	None		
9	n/a		
9	Yes		
10	Ownership; single-process owner	Single process owner	Lack of single owner
10	Pre-induction communication; forms/aircraft are reviewed prior to PDM induction; helps prepare battlefield; starts communication between field/PDM site	Planning; communication	Communication (pre)
10	Money…budget on depot side to cover admin expenses; post-PDM visits	Funding; communication	resources; communication (post)
10	Communication is biggest void; funding to support post-PDM visits...helped reduce DRs; pre-induction key to smooth PDM--allows depot/field mx crosstell on individual jet basis	Planning; communication; funding	Communication (pre); communication (post); resources
10	TS at Tinker just restarted; must restore reputation with customer; also new people on team (turnover pains); friction between SPO and depot mx	Teamwork	Improved teaming
10	AMC's lack of involvement; limits funding/prioritization put on TS program	Acceptance	Improved teaming; consensus
10	info sharing; unsure what's being found at other sites; no database/website access	Information sharing	Better info sharing
10	Single office/team/POC with full responsibility for PDM SORs and participating wings	Single process owner	Lack of single owner

(yellow)	ANG (Field Unit)
(orange)	OC-ALC (Mx)
(blue)	AMC (depot liaison at OC-ALC)
(light yellow)	AAII
(magenta)	ANG (MAJCOM/ALC Staff)
(green)	OC-ALC (SPO)

Question 1:	What is the greatest benefit of OTS?		
	Cluster	Count	
	Quality	4	
	Confidence	2	
	Communication	1	
	Teaming	1	
	Understanding expectations	1	

Question 2:	What is the primary driver leading to this benefit?		
	Cluster	Count	
	Info sharing	5	
	Communication	4	
	Knowledge sharing	2	
	Teamwork	1	

Question 3:	How is TS-related info shared between your unit and other units within the TS community?	
	Cluster	Count
	Oral/written feedback	5
	Shared website/database	4
	Standard DR process	2
	Unknown	1

Question 4:	Is there a single process owner for TS? If so, whom / what organization?	
	Cluster	Count
	No	8

Question 5:	Is there a team dedicated to TS process improvement?	
	Cluster	Count
	No	6
	PSWG	1
	In-house only	1

Question 6:	Is there a mechanism / forum where TS process-related issues are discussed, potential improvements vetted, or benchmarking opportunities discussed?	
	Cluster	Count
	In-house only	3
	None	3
	PSWG	1
	Unknown	1

Question 7:	What is the long-term goal(s) of TS? Is there an end state? If so, what is it?	
	Cluster	Count
	Temporary program	5
	Permanent program	3
	No long-term goal(s)	1

Question 8:	Are there metrics used to track the performance of the TS program? If so, what are they; how often are they reviewed; and by whom?	
	Cluster	Count
	Deficiency Reports (DRs)	5
	No metrics	2
	TS Inspection Findings	1

Question 9:	Are the metrics in line with the long-term goal(s) of the program?	
	Cluster	Count
	n/a (metrics are not TS specific)	8

Question 10:	What, in your opinion, is the biggest void or area in most need of improvement related to the TS program?	
	Cluster	Count
	Improve pre-PDM communication	4
	Improve post-PDM communication	2
	Improve funding	2
	Identify single process owner	2
	Improve teaming	2
	Improve information sharing	1

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Vita

Major Eric E. Morgan graduated from Wheatland Union High School in Wheatland, California. He entered undergraduate studies at the California State University in Chico, California where he graduated with a Bachelor of Science degree in Civil Engineering. He was commissioned through the Air Force Officer Training School at Maxwell AFB, Alabama. He later earned a Master of Science degree in Engineering Systems Management from St. Mary's University in San Antonio, Texas.

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14. ABSTRACT
In an effort to improve the quality of its KC-135s returning from programmed depot maintenance, the ANG requested to perform a portion of their acceptance inspections on aircraft while still at depot. This request evolved into the Team Spirit program. Following its implementation, Team Spirit reportedly drove average downtimes from 52 days to 14. In 2007, the TS team earned the Chief of Staff Team Excellence Award and the program was designated an Air Force Best Practice.
Since earning these accolades, the program has undergone scrutiny over increasing costs. Decision makers placed the program on hold and directed a business case analysis (BCA) be conducted to determine the way ahead. Although the BCA confirmed costs were in fact an issue, the overall results favored continuation of the program for myriad other reasons. Despite the BCA, scrutiny of the program had not completely waned. Evidence of revenue losses not only served as the impetus for the BCA, but also identified a need for a qualitative analysis of TS processes in an effort to identify potential areas for improvement—hence, the focus of this study.

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